MTM

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In This Issue . . .

Featuring—1960 International MTM Conference Holland

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MTM

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

The Journal of Methods-Time Measurement is dedicated to the technical aspects, application development and general news items concerning the advancement of MTM.

The Journal encompasses the fields of endeavor that were formerly publicized in the MTM Newsletter and MTM Bulletin.

The technical section of the Journal is concerned chiefly with recent research developments both from the established research program at The University of Michigan, Ann Arbor, Michigan, and from somewhat smaller allied projects being conducted throughout the Association membership.

New applications of MTM as well as refinements of established applications are presented in the Application Section to illustrate specific approaches to management problems that can be solved through the use of Methods-Time Measurement.

Current events in the lives of persons associated with MTM are described in the general news section.

The Editorial Staff welcomes contributions for all three sections described.

MTM

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Editor . . . . . Richard F. Stoll

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Editor's Note:

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MTM FEATURES

INTERNATIONAL MTM CONFERENCE

Address of Welcome

By

Ir. R. F. Volz

President of the

Netherlands-MTM-Association

Ladies and Gentlemen,

On request of the International MTM Directorate, the Netherlands MTM Association has prepared this International MTM Conference, the second to be held in Europe. I am therefore privileged by the Board of the Netherlands-MTM-Association to welcome you at this opening session. It is a pleasure to greet Prof. Delmar W. Karger, the President of the MTM Association for Standards and Research and the further conferees from the United States. It is most satisfying to have at this conference several participants from the country where MTM was born and where the application, research and the further development is intensive.

Mesdames, Mademoiselles et Messieurs,

Après la conférence MTM internationale qui avait lieu à Paris en 1957, le Directoire MTM internationale a demandé à l'association MTM Néerlandaise d'organiser cette deuxième conférence internationale en Europe. C'est donc de la part du Conseil de l'Association MTM Néerlandaise que j'ai l'honneur de souhaiter le bienvenu à Monsieur Soumagnac, le président de l'Association MTM Francaise, ainsi qu'au nombre considérable d'autres participants de la France.

Meine sehr verehrten Damen und Herren,

Im Namen des Vorstandes des Niederländischen MTM-Vereins, habe ich die Ehre Herrn Walter Hebeisen, dem Vorsitzenden des Schweizerischen MTM-Vereins herzlichst zu begrüssen, sowie den anderen Teilnehmern aus der Schweiz.

I further welcome Mr. Holger Bohlin, managing director of Svenska MTM Föreningen and Mr. Hassel, the president of the Norwegian MTM Association, the youngest in the row of national associations. To you and to the large number of participants from Sweden and Norway who have come to this conference we express our cordial welcome. I regret not being able to do this in your own language.

To all sister-associations the Board of the Netherlands MTM Association expresses its gratitude for the considerable cooperation in preparing this conference. In the coming days we shall have speakers bringing interesting papers from all their regions. It is a pity that there is one exception as we have no representatives of the Japanese MTM-Association at this meeting obviously due to the distance.

In addition to the conferees from the countries where the application of MTM is guarded by an association, we have at this conference participants from countries where no MTM association has yet been formed. It is with much pleasure that I welcome conferees from Great-Britain and from Spain.

Auch in der Bundesrepublik West Deutschland ist noch kein MTM Verein entstanden. Es freut uns sehr, trotzdem eine erhebliche Zahl

deutscher Teilnehmer an dieser Tagung begrüssen zu können, woraus hervorgeht dass das Interesse für MTM auch in Deutschland sehr schnell anwächst.

Dames en Heren,

Na de begroeting der buitenlandse deelnemers moge ik namens het Bestuur van het Nederlands MTM Concotschap de Nederlandse aanwezigen welkom heten. En wel in de eerste plaats de heren G.H.P. Veldkamp en G. A. Feenstra, leden van het dagelijks Bestuur van het Nederlands Instituut voor Efficiency, de vereniging waarmee het Nederlands MTM-Genootschap zo nauw samenwerkt en wier bureau, in het bijzonder de Heer G. J. Langenberg, het leeuwenaandeel van het voorbereidingswerk voor deze internationale conferentie heeft verricht.

In de tweede plaats ir A. Moens de voorzitter van de Vereniging Ontwikkeling Arbeidstechniek, de ondervereniging van het N.I.v.E. waarmede het MTM-Genootschap zo goede betrekkingen onderhoudt.

De Heer L. de Vries, directeur van het Technisch Filmcentrum, producent van de film die hedenmorgen voor ons zal worden vertoond en Drs. J. Hagen secretaris van de Contactgroep Opvoering Productiviteit op wier initiatief de film werd vervaardigd en die als vertegenwoordigster van de European Productivity Agency, de E.P.A., voor de financiering van deze film heeft zorg gedragen.

Voorts de bestuurders van de bij het Genootschap aangesloten bedrijven en instellingen die door de vorming van een garantiefonds deze internationale conferentie hebben mogelijk gemaakt en de directies van de bedrijven die morgen, op de tweede conferentiedag, gastheer van een werkgroep zullen zijn. U sta mij toe, dat ik niet allen bij namen noem.

Dan de Commissieleden van het Nederlands MTM-Genootschap, waarvan velen zich veel tijd en moeite hebben getroost voor de voorbereiding van deze conferentie onder leiding van de Heer Reyn G. Brusse, voorzitter van het voorbereidingscomité en tenslotte alle verdere Nederlandse deelnemers aan de conferentie. U allen heet ik van harte welkom. Wilt U mij thans toestaan nog een enkel woord te spreken tot onze buitenlandse bezoekers.

Ladies and Gentlemen,

Before opening this conference I should like to speak a few—more or less personal—words specially to our visitors from abroad. Some of you are visiting the Netherlands for the first time, others were here before, but for all of you we will try to make use of your stay to make you more acquainted with this country. We have taken this into account when composing the program for the conference and we have tried to do this in such way that nothing will derogate from time and intensity to be given to the subject MTM.

This evening there will be discussions on the international coordination and tomorrow the conference will split into five working-groups. The preparing committee is of opinion that both, coordinating discussions of tonight and working-groups of tomorrow, will have better effect according to the group members being personally acquainted. For this reason the forming of working-groups will already take place this morning, while during the afternoon a joint excursion will be made with ample opportunity for better mutual contact in free surroundings than would be possible in a conference room.

It is quite obvious that for this excursion Netherlands flowering bulb-fields have been chosen.

Tomorrow, when gathering in small groups with the aim to discuss and study special items, you will find that Holland is a small country. Two groups will operate at the eastern border, only a few miles off the neighbouring Germany, one group will work near the southern border close to Belgium while two groups will remain in the Western part of the country, but all of you will be less than 2 hours from each other and from this place. You will not only spread geographically and to different branches of industry, but there will still be a third difference, as some of the groups will go to factories where MTM is in intensive use, while other groups will visit factories where MTM is in the beginning of its application or a little on its way.

It is remarkable that for all groups speakers turned up for the subject Standard Data. This shows that the one starting point Methods-Time-Measurement leads through different ways and different branches of industry to an equal development: Standard Data.

Then after we have the third day to get reports on different subjects and experience from several specialists we will on the fourth day have the opportunity for reflection in informal contact during the final excursion. Contrary to the first excursion where we may enjoy perhaps the greatest expression of nature, the

blossom, we will on the second exursion pay attention to the battle of man against nature: the securing of the low-countries against the attacks of storm floods. This battle has been going on through the whole history of the Netherlands and it is typical for this country and its population. It resulted in great constructions and still greater projects.

May the work of this conference follow the sign of these two excursions, starting with the contemplation of nature and its manifestation in its whole colour scheme and all its graduations, ending into a great work to the benefit of human coexistence. With this wish the Board of the Netherlands MTM-Association thinks its task of preparing this second MTM Conference being ended. So I now declare the Conference being opened.

THE EVER-GROWING VALUE OF MTM

By

Harold B. Maynard, President

International MTM Directorate

This first full scale conference arranged by the International MTM Directorate comes at a peculiarly appropriate time. It comes when the MTM procedure has been used by enough different people in enough different industries in enough different countries for a sufficient number of years to enable us to make a fairly sound assessment of the present value of the procedure to industry. It also comes at a time when we are beginning to see new uses, new applications and new developments, based on the MTM procedure, which give promise of much greater things yet to come.

The MTM procedure has had a rather remarkable record of growth since it was first placed in the public domain in 1948 through the publication of a book giving a full description of the system. The word spread rapidly among industrial engineers that here was a development which they should examine seriously, for it appeared to hold great promise both for methods improvement studies and work measurement.

A few months ago, the MTM Association for Standards and Research decided to find out just what the impact of predetermined time systems had been on American industry. It asked the firm of Stewart, Dougall and Associates, who are market research people and who have no connection with work measurement activities, to make an objective survey to determine to what extent predetermined time systems are being used. A scientifically-constructed sample of 497 companies yielded findings which are projectable. Interviews conducted with the 497 companies showed that 327 companies used work measurement. Of these, 96 companies or about 30% made full-fledged use of a predetermined time system, that is they used it for work measurement as well as methods improvement, estimating, and so on.

By far the greatest numbers of those who used predetermined time systems used MTM.

An interesting sidelight was revealed by the study as the result of questions designed to ascertain union attitudes. Many people have been influenced by a handful of individuals with axes to grind to believe that unions in general were very much opposed to predetermined time systems. The exact opposite is true. Of the 96 plants in the survey that made full-fledged use of predetermined time systems, 62 were unionized. It was found that at the time the system was first introduced, 44% of the local unions involved were in favor of using a predetermined time system. At the time of the survey in September of 1959, six companies reported that their union favored the predetermined time system for everyone who said their union did not favor them. It was also found that fully half of the unionized plants felt that the introduction of a predetermined time system actually improved labor relations.

With so many people interested in and using a predetermined time system, it is only natural that there should have been some new developments. Let us review some of the things which have been happening to MTM, starting off with a brief review of the past.

The research and trial application work which led to the development of MTM was largely done during the period from 1941 to 1946. At the end of this time, the system seemed to have been sufficiently developed to justify sharing it with others, so during 1947, the developers put together a book describing the results of their researches, the predetermined time system they had developed, and the early tests and applications they had made. This book was published in May, 1948, under the title of Methods-Time-Measurement by Maynard, Stegermerten, and Schwab.

The authors were careful to point out in this book that although they had learned a great deal about motions and motions characteristics as the result of their researches, there was a great deal more that was yet to be learned. They invited others to join in the research work yet to be done, and urged them to share their findings with one another. This attitude bore fruit as we shall presently see.

The publication of the book stimulated great interest in predetermined time systems

in general and MTM in particular. In due time, the book was translated into French, Swedish, Spanish, Italian, German, Japanese, and Dutch, and this stimulated research interest in other countries of the world. Before long, research findings and suggestions for changing the original MTM system began to filter in to the MTM originators from all parts of the world, and it became evident that unless something was done to control the orderly development of the procedure, the result would be nothing less than first class chaos.

A group of interested practitioners, therefore, got together in 1950 and decided to organize the MTM Association for Standards and Research, which was eventually incorporated in 1951. The Association was charged with the responsibility of seeing insofar as was humanly possible that the MTM procedure was used professionally, at least, only by those who could prove upon careful examination that they were qualified to use it. The Association was further designated as the custodian of all new research information and was authorized to have needed research studies made as time and funds permitted. Membership in the Association was made freely available to any professional consultant, industrial company, or university professor who could meet the Association's admission requirements.

The establishing of the Association was a big step in the right direction of insuring the orderly development of a widely used procedure which had been placed in the public domain in the fairly early stages of its development. The Association immediately undertook some researches into certain areas in which additional knowledge was necessary and made its findings available to its members and the public-at-large through a series of research reports. Later on when funds were available, it contracted for additional research studies with the Engineering Research Institute of the University of Michigan. This made it possible to bring to bear additional skills from other disciplines on the research studies and it insured complete objectivity in the published findings.

But even this was not enough to channel research activities in a way which would permit the orderly accumulation of knowledge. Before long, people in other countries became interested in MTM, and they began to attempt to do research work also. As was true at first in America, too much of this was more in the nature of research for the sake of change rather than research for the sake of gaining worthwhile new knowledge. Many of the changes suggested were based on a lack of understanding of how the procedure should be applied which always seems to result when one attempts to learn how to use a predetermined time system merely by reading a book.

In any event, it soon became evident that the equivalent of an MTM Association was going to be needed abroad, too. A start was made by establishing overseas chapters of our American MTM Association, with the first chapters being set up in Sweden and Holland. In due time, it was decided that these chapters could be coordinated better by an international organization, so in 1957 the MTM International Directorate was set up in Europe.

I have given this historical background of what has been done to encourage the orderly development of MTM, because I feel that it is necessary in order to understand the new developments that are taking place in the field in increasing volume today.

Basically, there are two kinds of developments. We might call these :

1. Analytical developments
2. Synthetical developments

The analytical developments are coming from detailed research which has as its purpose the gaining of new knowledge about motions and motion characteristics. This is the kind of research that is being done in universities, such as the MTM Association sponsored research at the University of Michigan, by groups of MTM practitioners such as the Swedish MTM Association, or by serious individuals who have a passion for discovering new knowledge. Let me give you three examples that illustrate what is being done in each instance.

The University of Michigan is at present engaged in studying the basic MTM motion which is called Apply Pressure. Not too much has been known about this motion up to now. During the course of the original research we noticed that a hesitation seemed to occur whenever it was necessary for an operator to exert pressure.

In screwing a plastic top on a bottle , for example, when the cap had been run down as far as it would go, the operator would exert a final pressure to make sure that the cap was tight. In fact, we called this Final Tighten at first. Then we noted that a similar hesitation during which there was no noticeable motion occurred when an operator pushed on a push button or just after grasping a lever which

offered considerable resistance to being moved. We found that two different time values occurred for this motion with remarkable consistency, and eventually were able to identify two kinds of Apply Pressures for which we established constant times.

These time values have been used successfully for over 15 years without any particular problems developing, but many conscientious MTM practitioners felt they would like to have more understanding of the true nature of the motion. Accordingly, the MTM Association asked the University of Michigan to do the necessary research.

The laboratory phase of the study has been completed and the industrial phase is under way. But one of the laboratory findings will illustrate the point I want to make. In studying the Apply Pressure that is used to activate a push button, it was found that in reality it is composed of five motions. These were identified as Apply Force, Travel A, Dwell, Travel B, and Release.

Then a study was made to see whether these would vary as the force required to activate the push button increased. This was done to test the validity of treating Apply Pressure as a constant. It was found that the time for Apply Force and the Release did increase slightly as the force increased, but the Dwell time decreased. The increases and decreases tended to cancel out, so the conclusion can be drawn that it is proper to treat Apply Pressure as a constant.

Now, what practical value does this have? The time value for Apply Pressure will not be changed, for it was confirmed by the study. But the practitioner now understands more clearly what happens when an Apply Pressure occurs (or will when the report is published). He thus gains greater confidence in the correctness of what he is doing. If a worker challenges the correctness of allowing the same time for pressing a push button with a soft spring and one with a stiff spring, the analyst can explain exactly why it is that this is proper.

Much of the research work done thus far has had this same end result. It has not changed the basic MTM time values much and probably won't since by now they have been found to be satisfactory in literally millions of applications.

But it has helped the practitioner to apply the MTM procedure more understandingly, and it has helped management and labor alike to gain greater confidence in the soundness of the MTM procedure.

As a by-product of the Apply Pressure Research, the research group became interested in developing some kind of apparatus which would permit collecting time data more quickly and more accurately than has been possible with the film analysis procedure previously used. In pursuing this, they have now developed an Electronic Data Collector which permits the quick and inexpensive collection of vast quantities of accurate time data. This will not only speed up future research projects, but it will make possible new areas of investigation that could not previously be studied due to the limitations of existing measuring equipment.

The Swedish MTM Association has taken an entirely different approach. They recognized that physiologists have been studying the human body for years. Reaction times, neural paths, and so on have been studied in detail, and a great deal of information has been compiled. So far, however, no serious attempt has been made to correlate the data gathered by the physiologists with the data gathered by industrial engineers, at least on a scale of any magnitude.

The Swedish group has, therefore, set up a study project in this area. I am not in a position to report on the findings at this time, for as far as I know the study is not yet finished. Our Swedish friends will perhaps tell us during this conference just how their project is progressing. It is evident, however, that in due time they are going to come with additional new knowledge about motion and motion characteristics which will be of value to all of us.

An outstanding example of a piece of research work done by an individual is the study made by M. Claude Catelas of France on the time required to develop sufficient skill through practice to meet the MTM predetermined time standards. M. Catelas went into considerable depth in pursuing his studies and has written a book describing his findings which is just now being published in French.

M. Catelas classified all MTM motions into three categories. The first he called kinesthetic movements which include such movement as "reach to an object in a fixed location" and "transfer grasp." The second category he called movements directed by the mind or by sight. These would include a "reach to an indefinite location" and a "Glb" which is a grasp where some difficulty is experienced in making it. The third category is called movements

directed by the mind and by sight and includes such motions as "reach to a very small object," "grasp an object jumbled together with other objects," and the various kinds of "position."

M. Catelas found that the kinesthetic motions could be learned very quickly. The second category took more repetitions to learn, and the third category the most of all. This is basic information of value to all MTM practitioners. M. Catelas goes on from there, however, and suggests practical applications for this new understanding. He suggests a method of job evaluation based on the difficulty of the motions involved in any repetitive job. He suggests a method of paying learners during the learning period that will stimulate them to master the work in a reasonable period of time. He knows how, by taking the categories of motions involved into account, a progressive assembly line can be balanced more intelligently.

I have not attempted to read his book carefully, for so far it is available only in French. I am happy to commend this kind of research however, for it will help us all to use predetermined time systems more understandingly and as a means of solving some of our difficult production problems. Back in 1948, we included in our book as a suggested use for MTM Research—particularly in connection with methods, learning time, and performance rating.

M. Catelas, by his work, has shown what can be accomplished by research into these areas. And incidentally, as a by-product, his researches have tended to confirm the soundness of the original MTM data, which must be a matter of gratification to all who have been using this particular predetermined time system.

Let's turn our attention now to the second kind of new developments which I have called synthetical developments. The analytical developments seek to learn more and more about the characteristics of motions by breaking them down into ever finer subdivisions. The synthetical developments are just the opposite. They tend to make more and more combinations of motions, usually in order to make it quicker and more economical to establish the time for doing a job.

The synthetical developments have been made largely by practitioners—either consultants or company industrial engineers—interested in the application of MTM for work measurement purposes. The objective is always to make MTM quicker and easier to apply. This is accomplished basically by reducing the number of decisions it is necessary to make in order to set a standard.

To illustrate this, let's take the common motion sequence of reach, grasp, and move. The operator reaches to an object, picks it up, and moves it to another location. In establishing a time for this simple motion sequence by conventional MTM, it is necessary to make eight decisions. The analyst must decide that a reach occurs, what type of reach it is, and what the length of the reach is to the nearest inch. He then must decide that a grasp occurs and must decide what type of grasp it is. Finally, he must decide that a move takes place, he must classify it as to type, and must determine the length of the move to the nearest inch. This requires eight decisions and more if the hand is in motion at the beginning of the reach or the end of the move or if a violent change of direction takes place during either the reach or the move.

The simplified MTM data published in the book Methods-Time-Measurement were perhaps the first attempt to reduce the number of decisions required. They eliminated the case of Reach and Move and thus reduced the number of decisions to six. In addition they rounded off the predetermined time standards to easily remembered whole numbers which included a 15% allowance for fatigue and personal and unavoidable delays. Thus, they made it possible to establish a standard more quickly than with the use of the conventional data, but there was a slight sacrifice of accuracy.

Much more recently, this process of reducing the number of decisions required has been carried much further in the Unified Standard Data procedure, commonly known as USD. Here, to establish the time for reach, grasp, and move, only three decisions are required, one to decide that the reach-grasp-move combination takes place, the second to decide that the lengths of the reach and move average out as short, medium, long, or very long, and the third to decide on the difficulty of the grasp involved, all of which can easily be determined by casual inspection.

Analysts who have been trained in conventional MTM are likely to be quite concerned about the accuracy of the USD approach when they first try to use it. This has led some people to advocate not giving detailed MTM training to analysts who will only be using USD. Personally, however, I would prefer to give the analysts complete training so that they understand thoroughly all that is now known about motion

characteristics and then train them further in how far they can go in the direction of simplification without sacrificing accuracy to an impractical extent.

As a matter of fact, USD is not a fixed, unchanging set of data but an approach under which the data can be modified to give any degree of accuracy desired. On short cycle work where very few motions are involved, it does not pay to get very far away from basic MTM. On long cycle work, however, where the law of averages will work for you if you will let it, it is possible to use a surprisingly large number of simplifications and approximates without sacrificing accuracy to any important degree.

And simplification is necessary if standards are to be established at all on certain classes of work. For example, our firm has recently been studying the assembly of a certain mechanical device which is about three stories high and is about 16' by 16' at the base. Into this assembly go a vast number of component parts, castings, forgings, weldments, sheet metal parts, pipes, motors, control panels, subassemblies of various sorts, and many others. Each assembly is different to a small or large degree from every other assembly. The average device requires about 200 standard hours to assemble.

To establish a standard on this work by conventional MTM would take so long as to be uneconomical. To do it by time study would be equally impractical, because the resulting data would be of little value on future but different devices.

With USD however, it has proved to be economically feasible to measure the work and set standards. It takes between four and five hours of analytical work to establish a one-standard hour time allowance the first time, but thereafter, the data are available for establishing standards on future assemblies in a fraction of this time.

Let me emphasize again that USD is an approach and not a single set of data. The data which were published in the magazine, Factory, about two years ago were established for a specific application—setting standards on a tractor assembly line in Sweden. Many people have attempted to apply these data as is. Some have been successful and some have not. It depends upon how similar their conditions are to the conditions for which that particular set of data was developed.

It can be seen from this discussion of USD that basic MTM furnishes the tiny building blocks from which larger building blocks can be put together. The USD approach gives one kind of building block. Time formulas or standards data represent another.

Time formulas and standard data have been developed and used by knowledgeable industrial engineers for a number of years. I cut my own teeth on these procedures at the Westinghouse Company way back in 1923. In those days, we had only time study as a tool of work measurement. It took considerable time to observe and measure each element in a given class of work under sufficiently varied conditions to determine whether the element was a constant or a variable, and if a variable, how much it varied with what job characteristic.

Now that we have MTM, the formula development process requires much less time—perhaps a third or a quarter of what it used to take. The tiny building blocks provided by MTM make it possible to build up elemental times quickly and easily, and when these elemental times are put together properly, a time formula which did not cost much to develop is the result.

In view of the fact that time formulas and standard data have been used for so many years, it may seem strange that I would discuss them under the head of new developments. Yet to many people, they are new developments apparently. At least, many people are not making use of this particular device when they profitably could. Just recently at a Director's meeting of the MTM Association, it was unanimously agreed that the current lack of understanding of the value of time formulas and how to develop them was appalling and that corrective action was necessary for the benefit of all industry. The Association has, therefore, decided to develop a special training course to be given by its professional members as a means of correcting this lack of appreciation of the possibilities for economies that lie in the time formula approach.

Time formulas reduce still further the number of decisions which have to be made to establish a standard. Where there is a class of work embracing a number of different parts of varying characteristics such as milling machine work or a stores and shipping activity, time formulas are the answer to the work measurement problem, and if they are derived with the aid of predetermined time standards, they can be developed economically.

But where the work is extremely varied in nature and when there is practically no repetition, even time formulas require too many decisions in their application to make them economically practical. Such is the case with maintenance work where every job is different and even the methods that would be used by different workers to accomplish the same job are likely to be different.

Here still another approach is needed if work measurement is to be practical, but once again MTM has provided the answer in the form of Universal Maintenance Standards or UMS. This procedure has attracted a good deal of attention recently and has been written up frequently in the industrial press. An article in the March issue of Factory was one of the most recent stories. So it probably is not necessary to describe this procedure in detail—and time, of course, does not permit it anyway. But I would like to point out that it is recent developments in the application of predetermined time systems that have made the economical measurement of maintenance work possible.

The tiny building blocks of MTM have also made it possible recently to develop data for the measurement of office work which are well-nigh universal in their application. This, too, has been written up and a new book on Universal Office Controle is about to come off the press.

All of these developments are synthetical developments, the putting together of basic MTM data into a form which reduces the number of decisions required to apply it to a practical number. These are, for the most part, relatively new developments, developments which when they are spread more widely throughout industry will prove to be one of our most potent weapons in our current battle against rising costs.

And there will be other developments too in the future as the value of the tiny building blocks provided by MTM becomes more fully recognized. The ingenuity of industrial engineers is boundless, and we can expect new and novel applications tailored to fit specific and unusual situations as the full potential of MTM is harnessed.

And this will be good, good for the economy of all of our countries, good for the companies where the applications are made, and good for all of our people who will benefit from the increased standard of living which will result.

The tools for accomplishing this are at hand. It is for us to see that they are put to proper use. The International MTM Directorate can play a role of major importance in seeing that the MTM procedure is spread soundly and competently applied in an increasing number of companies in all of our countries.

THE SWEDISH MTM-ASSOCIATION

A presentation before the 2nd International MTM-Conference in Holland, April 1960

By

Holger Bohlin,

Director of the Swedish MTM-Association

The Swedish MTM-Association is now about four years old as it was founded on December 28 in 1955. In 1960 its annual budget amounts to 412,000 Swedish Crowns, which approximately corresponds to U.S. $80,000. Presently, the association employs 8 persons, 7 of whom being employed full time.

Considering the fact that Sweden is a very small country of only 7 million inhabitants one can conclude that MTM has reached wide usage in Sweden when compared to many other European countries. The idea of cooperation in between companies and individuals in MTM-matters has also found great support in Sweden.

How could this development take place?— I shall try to answer this question briefly. However, I shall then limit myself to some aspects of MTM-usage in Sweden and to some practical aspects of the Swedish MTM-Association. I do not intend to build any theory to explain events.

Background

Some facts in the development of MTM-usage in Sweden are comparable to same in other European countries. Thus, MTM was first introduced into a Swedish factory in 1950. The first MTM-course, open to the public, was held in 1951. An introductory booklet on MTM was published in 1952 and in 1953 the American textbook became translated and printed.

The main thing during this opening stage, however, was the fact that the first MTM-installation in Sweden turned out to be a real success. The installation was made at Volvo-Pentaverken, the engine-division of the automobile company Volvo. It became a success technically as well as socially. Consequently, management of Volvo-Pentaverken greatly contributed to the rapid progress of MTM in Sweden by doing a careful job at their own plant.

A more general reason to the advancement of MTM in Sweden is the fact that both management and labour believe in the value of wage incentives in industrial production. Management claims that incentives lead to lowered costs via higher productivity, and labour claims that incentives lead to higher earnings. The raise in productivity is usually considered to be reached in at least two ways, which are:

1. Incentives are supposed to ensure a strong interest in output on the part of labour.

2. Incentives are supposed to compel management to organize and schedule production efficiently into detail.

These sentences have been believed and repeated by a great many people in industry during some decades by now. Today we say in Sweden that the sentences may be correct when incentives are built technically correct, which has not always been done, however.

To build incentives correctly you need a tool, by which you can do three things simultaneously in an economic way. This means that the tool must facilitate:

1. Analysis and detailed job descriptions that can be communicated easily.

2. The measurement of time necessary to perform the job.

3. The development of new working methods.

Now, the interesting thing is that the results reached at in 1953 in Volvo-Pentaverken told Swedish industry that MTM might give the practical solution to the aforementioned requirements. And since then more and more companies have become interested in the application and development of MTM. The increase in interest in MTM was almost too

rapid, however. So, by 1954 the general MTM-situation had become somewhat confused.

By that time there were at least two data cards in use. The basic training courses varied in length from 60 to 200 hours. The MTM-instructors on these courses differed widely as to the knowledge of MTM.

A committee within the Royal Academy of Engineering Sciences got interested in the subject and arranged a conference on MTM in 1955. The conference assembled more than 400 participants. During that conference the audience asked for the establishment of an MTM-association.

To summarize: In 1955 the MTM-situation in Sweden was this,

1. One company had shown great benefits by the proper use of MTM.

2. The general MTM-situation was confusing.

3. Management and leaders of the unions realized that something must be done on an industry-wide basis in the fields of training in and application of MTM.

The tasks laid before the people who were to initiate the establishing of an MTM-association thus were: to establish rules for the new organization, and to find an individual who could direct and inspire the work of the association. Both these tasks were solved, and we were especially fortunate to have Mr. Per Soderstrom (Director of Volvo-Pentaverken) accept as Chairman of the Board.

Aims and Policies

A. As I have told you now, it is a historic fact that the Swedish MTM-Association was established on request from industry. According to my opinion this is of utmost importance when you want to consider the Swedish association. Apparently there was nobody offering a ready-made organization fit for his ideas and well-being. Industry requested that an association be built.

B. From the very beginning of the work on the Swedish association we benefited from the ideas and thoughts mould into the American MTM-Association for Standards and Research. In accordance with the needs and requirements in Sweden we concluded that the Swedish association should have three different aims. These are:

- to promote the technical development of MTM,
- to widen and intensify knowledge of MTM,
- to promote the correct application of MTM.

Each of these aims has been taken care of in its specific way by the three working committees of the association, viz., the research committee, the training committee, and the application committee.

C. One of the basic policies of our association lies in a rather specific evaluation of our services. We have said that regardless of the name of our association we must primarily look to the benefits of industry as a whole. Secondly, we shall consider the broader interests of our members. And thirdly, we shall serve the specific interests of MTM. This evaluation is based on the fact that MTM is no end in itself but a means to goals set quite independently of MTM.

D. In our policies we have also stated that our association shall specialize to tasks that are common to all or at least a great many MTM-users. And the tasks should be such that the members hesitate to undertake them individually of technical and economical reasons.

In practice this means that our association works on such tasks as:

- data cards,
- training and qualifications,
- research,
- the collection and distribution of know-how, especially as regards the application of MTM.

E. The association shall constitute a technical body in MTM-matters. Consequently, it does not take part in matters connected with collective bargaining.

F. It is our policy not to do consulting work as long as the consultants perform their tasks in MTM-matters properly, and as long as the consultants are ahead of industry technically. If the consultants would lag in developing new ways of using MTM the association should be enforced to reconsider this policy.

On the other hand we are not afraid of recommending the use of consultants when this be considered proper. Such recommendations have been given, when we presented a program on how to use MTM for maintenance work.

We combined our recommendation with two steps aimed at raising the efficiency of consultants. The first step was to conduct conferences and courses showing ways and means to use MTM for maintenance work. The second one was to include information on how to work with consultants efficiently.

Members, Fees and Finance

A. From the start of the association it has been agreed upon that the minimum activities require two persons employed full time. Thus, the constitution of the association is built to secure a minimum budget of about U.S. $20,000. To reach this goal we had to have companies and not individuals as members.

We have classified our members in the following way:

- Sustaining members; that is industrial companies (86 members presently), associations of employers (4), trade unions (1), training and research organizations (6), etc. (thus 97 sustaining members presently).
- Professional members; that is consulting firms (7 members presently).
- Personal members; that is paying members (none) and honorary members (2).

In total the association has 104 member firms and 2 honorary members. The association is still growing, and we hope to have about 110 members at the end of this year. The industrial firms being members employ approximately 90,000 workers.

B. The annual fee is built of two parts, viz., a basic amount and an additional amount. The latter part is depending upon the size of the member firm. The size of the industrial enterprises measured by number of workers and the size of consulting firms are measured by number of MTM-practitioners.

For industrial companies our annual fee varies from approximately U.S. $200 to $1,300. The consulting firms pay a minimum fee of about U.S. $400, and then their additional fee is unlimited so that the highest fee for a consulting firm presently amounts to about U.S. $1,000.

C. When the secretariat undertakes specific services to some of the members we charge the costs for these services on the members, if the service exceeds certain limits. Presently, these charges amount to half our annual budget.

All our services are carrying two prices, member prices and non-member prices. When we invoice our services, we then start by non-member prices, from which we deduct our "member-discount." Last year the total sum of these discounts amounted to circa 50% of the total of the fees, which is something that we are very proud of telling our members of.

Organization and Activities

A. On Fig. 1 we have shown our organization chart, which is to be commented upon here.

Organization charge of the Swedish MTM-Association

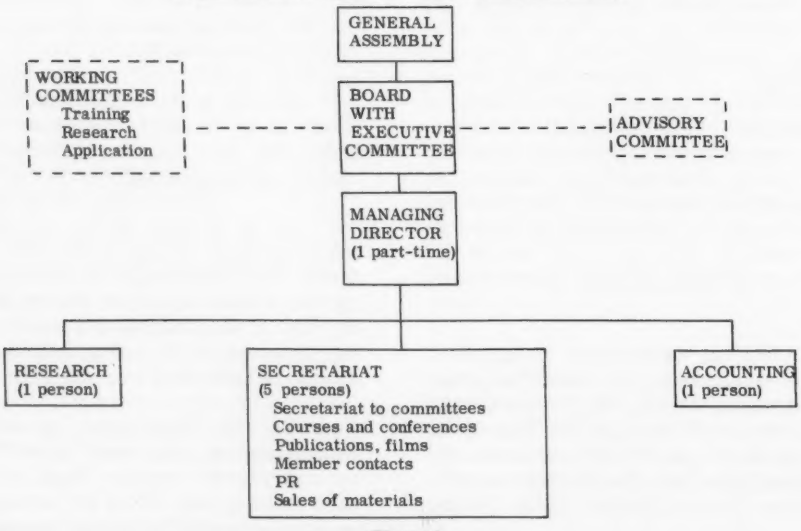


Figure 1.

B. The basic body is of course the general assembly of our members, and they meet once a year in principle. We then arrange these meetings, so that the participants will hear and see some new facts and traits in the development of MTM and its applications. Our annual meetings have thus become meeting places for many Swedes interested in MTM.

In 1959 we had 260 participants when the topic was Universal Maintenance Standards and a visit to a plant where UMS was being installed. In 1960, 390 persons visited our meeting to hear about work measurement in the office and about the use of consultants.

C. Our board of directors works by an executive committee that really takes part in the current activities of the association. The board also has an advisory committee for general counsel. This committee has representatives for the main organizations of employers, white collar workers, supervisors and labour.

D. The working committees have already been mentioned and in the chart it is now shown that they report directly to our board.

E. Our research activities got started in 1959 when our research engineer was employed. He has his working place at a laboratory, where scientific studies in industrial physiology are undertaken. Our research budget for 1960 amounts to circa U.S. $18,000.

F. The secretariat covers the main part of the activities of our association and the main functions of the secretariat are shown in the organization chart. Here I can add a few facts.

The MTM-Association examines MTM-technicians and now we have examined and approved approximately 2,300 persons in this respect. We are also running training courses for MTM-instructors. These courses are followed by a careful written and oral examination, and we have now approved about 100 instructors.

We have published three booklets on MTM-matters, and they have been sold in about 8,000 copies. Our MTM data cards have been sold in about 15,000 copies. We are also furnishing our members by forms for MTM-analysis, and hitherto we have sold these forms in about 500,000 copies. Each year we are sending our members some news bulletins on MTM-applications, and we have now distributed about 25 such bulletins.

G. The secretariat covers the main part of our annual costs, and its costs for 1960 amounts to about U.S. $50,000.

In Conclusion

MTM-associations are important, but most important of all is what goes on in industry. Success for new ideas and tools is built out in industry. Quite often it is built down on the factory floor itself. An association can be of assistance in this undertaking, but it can never replace the daily work in industry.

Sweden had a specific situation when our MTM-association was formed. Swedish industry took advantage thereof and formed an association for its needs and requirements. So, today you will find two cases showing that a strong MTM-association can be built.

- USA, a big nation
- Sweden, a very small country.

What else do you need in this respect, if you really want to start cooperative work in MTM-matters? I can assure you that you are having very good chances to gain much more than you are risking. By an MTM-association properly arranged you will find a new and fruitful way of building contacts in between people in different companies and in between management and labour.

SIMPLIFICATION OF RATE SETTING IN THE READY-MADE CLOTHING INDUSTRY BY MEANS OF WEIGHED (MEASURED) BASE TIMES

By

G. H. Vloedbeld,

Raadgevend Bureau Berenschot N. V.,

Hengelo (O), Holland

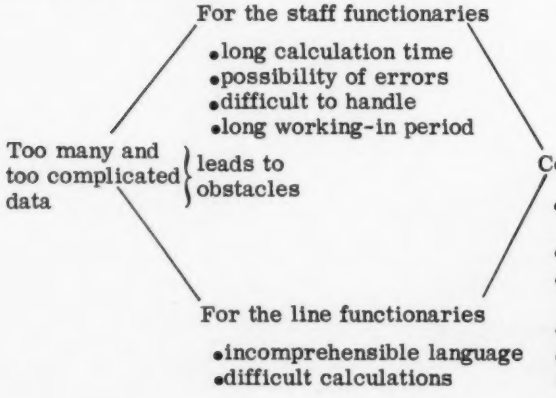
Problematics

As against the immense usefulness of the classic base times and the classic method of rate setting, there are a number of serious obstacles.

The number of time data is usually great and moreover the data are often complicated. Even for time-study analysts and rate calculators this presents an obstacle, because the time required to calculate the rate and the possibility of errors increase more than proportionately as the number of data and their complication become greater.

The entire procedure therefore becomes difficult to handle and requires a long working-in period.

For the line functionaries the classic base times and their setup (and consequently the ensuing "difficult" rate calculations) usually speak an incomprehensible language.



The consequences thereof are:

- The supervisor hardly accepts the responsibility for the rates in his department and assumes a passive attitude towards rate setting and work methods improvement.
- More complaints about rates arise than is necessary and dealing with complaints of this kind is apt to become one long road of suffering through misunderstandings between staff, line and labour rate control commission.
- The organization department is working full time on rate calculations and rate control, so that other important matters, such as work methods development, materials saving, quality control, etc., receive insufficient attention.
- Slow adaption to production changes is caused.
- Rate setting becomes costly.

Summarizing, we therefore see:

Consequences

- Work study dept. too busy with calculation work and rate control.
- Supervisor hardly accepts responsibility for rate.
- The line assumes passive attitude towards work study and rate setting.
- Complaints about rates.
- Slow adaption to production changes.
- Rate setting too costly.

In the past few years much has been done to evade the obstacles mentioned above. Generally, this was leveled at:

a. limitation of the number of data by:
   - not taking into consideration part of the influence factors.
   - simply concentrating different work methods when compiling a base time table.

   The result was that in many cases the rate became too inaccurate.

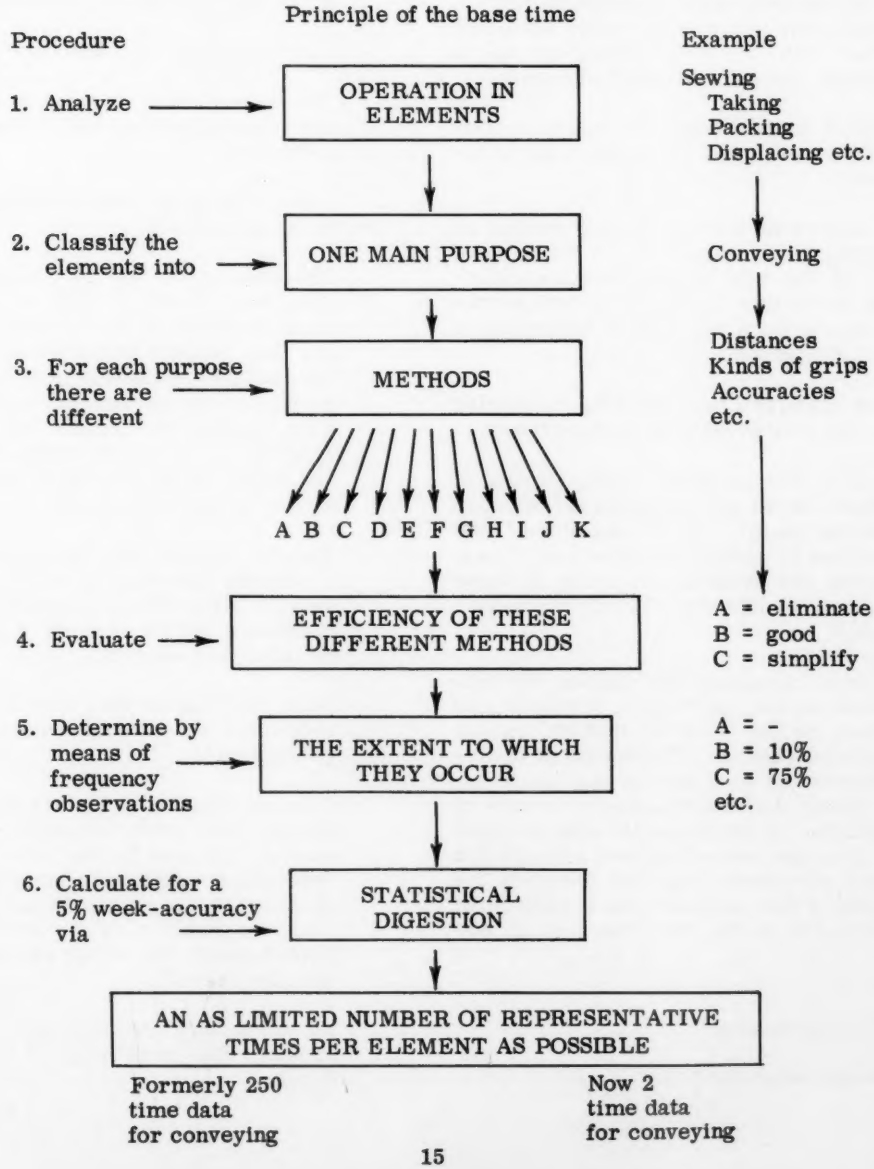
b. acceleration of the rate calculation by:
   - bundling different elements into a greater unit.

   This procedure is in many cases unworkable, because by so doing the work method can no longer be reproduced from the rate sheet, which may not be commendable in view of the work instruction and control on rates by the rate setting commission. In many instances there is, moreover, the possibility of inaccuracies and of an even greater number of time data.

The New Procedure

a. The principle of base times.

The fundamental ideas underlying the development of base times are outlined below.



b. Principle of rate calculation

When the number of time data is reduced to the admissible minimum, new possibilities are created for simplification and acceleration of the rate calculation.

The fundamental ideas that have led to further simplification and acceleration of the rate calculation were the following:

- In the case of a small number of base data it should be possible to have all data necessary for daily use printed on the rate sheet beforehand.
- Next to classification into elements, a classification into greater units should be designed, however without doing damage to the insight into the individual elements.
- Formulas to calculate the machine time should be converted to tables, easy to interpret.

On account of the fact that, depending on the operation, small variations in the form of application of the rate calculations are necessary, it is preferable for practical demonstration purposes to limit the further discussion to one particular operation.

As an example I have selected the sewing operation. The rate sheet is given separately.

All time data are stated in the heading of the rate sheet. In the example given of the operation "sleeve seam" and "lining sleeve" the seamstress has to use her machine four times. The elements are grouped according to these machine times. In this way "seam fragments" are obtained.

The rate calculator determines the necessary elements for each seam fragment and records them on the sheet by making checks in the available squares. If it should be desirable to record the sequence of the elements, one could insert sequence numbers instead of checks. Addition of the times for each element gives the time per seam fragment and addition of the times per seam fragment produces the net rate time. If this net rate time is multiplied by the allowance factor, the rate time is obtained.

Results

Whilst maintaining

- a 5% week-accuracy

and

- the required reproduceability of the work method from the rate sheet.

The following diversions from the classic method of rate calculation were observed in the ready-made clothing industry:

- The number of time data is approx. 4% of the original number.
- The time data are simpler in structure.
- Elements (work study language) are combined down to smallest operation units, giving access to the rate sheet for daily use.
- Time data and rate sheet are combined.
- The clerical work amounts to approx. 50% of the original quantity and typing is no longer necessary.

The procedure described above produces the following results:

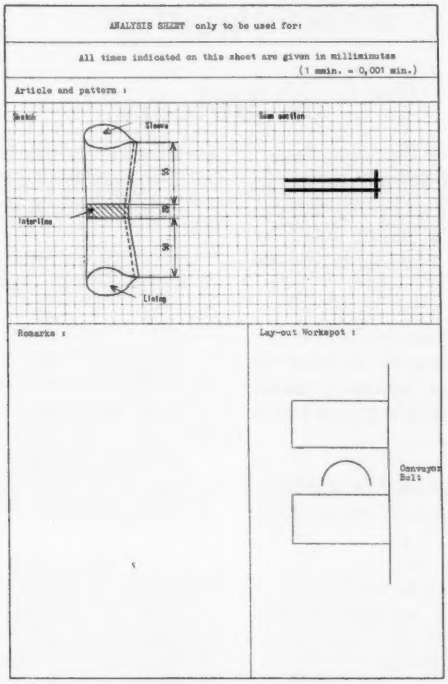
- The supervisor has an overall view of the data, can understand them and can calculate rates himself, or have them calculated under his responsibility by an assistant on the basis of standards provided by the organization department (work study analyst). This makes him accept his original responsibility again with regard to rate setting and work study will generally become a matter of more interest to him.
- For the organization department it means a considerable ease of work, so that other aspects of the organization and improvement of the rate setting procedure may be included in the development.

  Work relating to the rates in force will be restricted to taking random samples and giving advice.
- It is our experience that the number of complaints about rates lessening. We are of the opinion that this is due to the fact that the department supervisor has a better understanding of the rate setting procedure and feels responsible for his rates. This is of importance to the labour rate control commission as well.
- By simplifying the data and limiting their number, the possibility of errors is reduced.

The quicker way of rate calculation produces a shorter time in which the rate can be established. This in itself implies a swifter reaction to production changes and makes the rate setting procedure into a better tool for costing.

- In this way rate setting becomes less costly.

We are of the opinion that the use of MTM has to a large extent contributed towards the development of this simplification, which in turn has offered new possibilities for organizational improvement.



Operation : Join elbow seams of wool - and lining sleeves | Number : 13.4

Machine : lock stitch | Rpm:: 4000 | St/cm:: 3 | Fabric:: wool and lining | Date : 24-12-'58 | Compiled by : EE | Checked by : DV

PREPARATION: Take ≤ 30 cm S	Take 30 - 60 cm M	Take ≥ 60 cm L	Unroll - unfold	Spread (swing) material	Resize ≤ 10 cm S	Resize > 10 cm L	Align Normal	Align Accurate	Fold down	Under needle Normal	Under needle Accurate	Under needle Extra for pushing	Under needle Turn	Tack	MT Machine time	FINISHING: Needle in/out of fabric	From needle	Scissors Take	Scissors Put aside	Threads loosening 1st Cut	Threads loosening Extra Cut	Threads loosening Tear	Trimming Easy	Trimming Difficult	Ticket / Notch Insp.	Roll up - Fold up	Put away < 50 cm S	Put away ≥ 50 cm L	Particulars	Particulars	Particulars	Particulars	F Frequency	T Time in mmin.
17	23	29	18	15	6	9	6	12	11	12	18	8	15	11	X	12	10	19	8	6	13	11	12	18	19	19	11	14						
																Sew 15 cm (wool)																		
		I		I		I		III			I			I	26											I								163
																Sew 40 cm till hem																		
					I	I		II							50																			89
																Sew 20 cm (hem + lining)																		
					II	I	II	I							31																			76
																Sew 50 cm (lining)																		
					I	I	II							I	60		I	I	I	I						II		I						193
																																	Total	521
																																	Total x allowance factor 1,15 = RATE	600

REPORT OF GROUP B-MANUFACTURE OF SMALL METAL PRODUCTS SECOND DAY OF CONFERENCE

By

R. Mulders

Group B paid a visit to Meterfabriek, at Dordrecht. After a word of welcome by the director, the group listened to a paper read by Mr. Soumagnac "MTM et la rénumération du travail."
result

In this paper Mr. Soumagnac gave the result of an investigation held in a number of French factories using MTM, on how they linked the payment of the workers with the times found by MTM analysis.

The paper is given in full in "INDUSTRIELLE ORGANISATION" 1959 No. 9, pages 299-306.

During a visit to several departments of the "Meterfabriek," the group was shown how MTM had helped to develop more efficient working methods and work-bench lay-outs.

After this plant visit, Mr. Hebeisen gave a report on how he had developed MTM-Standard Data for transport work.

A summary of this paper was handed out at the conference.

The next introduction was by Mr. A. Grønseth, who told the group about the use of MTM at his factory: How it was introduced, what they used MTM for, the use of USD, problems with the quality of the parts, the demands that may be made on the organization, the building of a wage system with MTM and how MTM is regarded by the Trade Union Representatives.

After this discussion the day closed with a word of thanks by the group leader to the members of the group for their introductions and their cooperation in the discussions and to the director of the "Meterfabriek" for a very pleasant and interesting visit.

THE DEVELOPMENT OF MTM STANDARD DATA FOR TRANSPORTATION WORK

By

Walter Hebeisen

(Thun, Switzerland):

In the past few years the shipping business has become more and more an object of time and job-studies. It is almost generally known that the share of transport costs in the total wage-cost of a product amounts to between 20 and 50% in most cases. As a consequence of this large share and of the special nature of shipping work, the possibilities for economizing are very great. Savings in the transportation business can be effected by means of the following three measures:

1. Improvement of the factory layout
2. Improvement of work methods
3. Increase of working intensity by production premiums

All 3 measures require job-analyses and time-studies. With traditional stopwatch methods such researches, especially in the case of transport jobs, are very laborious and time-consuming. But we can observe that transport jobs are composed of a relatively small number of similar work procedures that occur again and again. As a matter of fact, only the distances vary, as well as the weights that must be lifted, put down, or moved around with vehicles. Instead of measuring these jobs again and again with a stopwatch or analyzing them singly by the MTM system, it means a great deal of time saved if time formulas and timetables are set up once and for all—for instance, a table that gives the time it takes to push a vehicle dependent upon distance and weight, or a table for the picking up of an object dependent upon height and weight. Such timetables can now be arrived at much better with MTM than with the stopwatch, as functions, for example, of weight and distance are already finely crystallized in the basic operations of MTM.

In what follows I should like to demonstrate to you how in a division of the textile industry such timetables or standard data have been set up with the relatively low expenditure of approximately 600 work hours. To this it should be emphasized that what was striven for was not the highest degree of scientific precision, but a working tool that suffices, without too high a cost, for the normal practical needs of an industrial shop.

We have found that the manual share of most of the commonly occurring shipping jobs consists of the following 8 activities:

1. Picking up and laying down objects;
2. Pulling and pushing vehicles;
3. Walking;
4. Climbing stairs;
5. Opening and closing doors;
6. Raising and lowering carriers;
7. Lifting and putting down objects with sack carts;
8. Lifting and putting down objects with flask and barrel trucks.

To this are added mechanical or mechanized transport jobs such as driving fork carriers and payload trucks, crane jobs, etc., which in their expenditure of time depend strongly on the performance data of the vehicles and are, therefore, not universally valid. These time data were not considered.

7 of the 8 basic activities were arrived at by MTM analyses. Only "Pulling and pushing vehicles" was analyzed with the help of films. The time data for walking and for climbing stairs were taken from the MTM Chart, but checked by means of the films.

With reference to the 1. activity, "Picking up and laying down objects," I wish to show you what the procedure in the formulation of the standard time data was. For better illustration I am having a filmstrip of such an operation shown to you.

You may observe the proper MTM analysis for the lifting of a 40-kg carton from a pallet.

Now if in a similar overall situation we lift not a carton but a bottle, a machine part,

or any object weighing 40 kg, the MTM analysis will not basically change, i.e., the time value for the work will remain about constant. Our researches have also shown that a variation in the volume of the object, given a constant weight, has no essential influence on the time element. The time value ascertained already has, therefore, a validity for practically all objects weighing 40 kg.

What happens now if the weight of the object is changed? With increasing weight the movements become slower and the worker alters his work method by performing additional motions. With the help of MTM analyses the time values for the various weights can be ascertained without difficulty.

The second factor having influence on the time value of the work analyzed is the height to which the object must be raised. By that we mean precisely the distance from the base on which the feet stand to the level of the object. The smaller this distance is the deeper the worker must bend and the larger the time value becomes. Here, too, with the aid of the MTM chart, time values may be obtained for the various heights.

An interpretation of all accepted analyses revealed that height may be divided into 3 intervals, for each of which a constant time value must be assigned. The errors committed thereby become so small that they may be neglected. The following were distinguished:

1. Interval from 0 to 50 cm: Instance A;
2. Interval from 51 to 100 cm: Instance B;
3. Interval over 100 cm: Instance C.

The results of the collected analyses are thus separately entered onto a system of coordinates according to instances A, B, and C. In this coordinate system the weights of the objects are entered on the abscissa and the normal time values are entered on the ordinate. In the sequence a straight line was laid through the points for each instance, so that this line gave the standard time values for the element "lifting" in function of the weights. With the standard time values thus arrived at we come, consequently, to average values, whereby the magnitude of the deviations may be considered admissible.

In order to be able to work rationally with these values in practice, symbols have been used to denote the various activities, just as is done in the MTM-system. Thus GH-A, for example, means "to lift object from a height of 0 to 50 cm": here the proper weight is inserted in place of the hyphen. The symbols were then brought together into a table, with the proper time values for weights of from 2 to 50 kgg. Analogous considerations lead to the normal time values for the work activity "Putting down objects." Here, too, the different (factors) were deduced from the straight line. The symbols are GS-A, GS-B, and GS-C.

For the second transport job, "Pulling and pushing vehicles," universally valid time values may equally well be obtained: here, too, it makes no difference whether the conveyance pushed or pulled is a sack-cart, a carrier, a platform-cart, or any other hand vehicle. The only condition is that the transportation take place over an even and smooth floor.

The course of movement with the pulling or pushing of vehicles comprises three phases:

1. The acceleration phase: the Start;
2. Moving with a constant speed;
3. The retardation phase: the Stop.

For the 2nd Phase there could be obtained a time value per meter, which is dependent only on the total weight to be moved, given a constantly even and smooth floor and an average rolling friction. The functions of the weights moved with established standard time values are, then, to be multiplied only with the number of meters of distance covered. The symbol for this first part of the element "Pulling and pushing vehicles" is FZ-M and FS-M, respectively, into which, in place of the hyphen, the number of meters over which the shipping takes place is to be substituted.

The precise evaluations of the films made here have shown that in traveling over narrow curves or through swinging doors there comes about a retardation approximately equal to 1 meter of travel over an even floor. Thus with narrow curves or with travel through swinging doors, 1 meter is to be reckoned in addition to distance actually covered. Perhaps it might also interest you to know that with small weights pulling and pushing require about the same amount of time per meter, while with larger weights pushing takes more time.

Since a stop necessarily goes with each start, the 1st and 3rd Phases may be taken together. Starting and stopping time are dependent exclusively on total weight to be moved so that, here, too, a standard time value in function of that total weight could be obtained. The symbol for this 2nd part of the element "Pulling and

pushing vehicles'' is ST-Z and ST-S, respectively, into which gross weight to be moved plus weight of vehicle is to be substituted for the hyphen. This graphic representation shows that with pulling starting and stopping time is almost twice what it is with pushing. This is first of all because the transport man, in starting and in stopping, must turn 180° each time.

The walking element was thoroughly examined with the help of films. With that a somewhat higher time value was found for walking per meter than the MTM Standard Time Chart gives it, because in our films the average pace length was 72 cm in contrast to an 86-cm pace with MTM. Evidently the Swiss worker takes more cautious steps than his American colleague does. We have intentionally chosen time per meter and not per step, because we wished to leave open the possibility of calculating transport time values based on factory plans without immediate reference to the worker.

All 8 transport jobs mentioned at the beginning have been brought together with their symbols and time values onto a ''Transport Standard Time Chart,'' for practical use.

The 1st table contains the standard times for ''Lifting and laying down objects.'' The 2nd table shows the standard times for ''Pulling and pushing vehicles.'' On the reverse side are entered the more widely investigated work motions, with their symbols and standard time values:

Walking per meter;
Climbing stairs;
Opening and closing doors;
Lifting and lowering carriers;
Lifting and laying down objects with sack-carts;
Flask and barrel trucks.

All time values, as on the MTM Chart, are given in TMU's (time measurement units), that is, in hundred-thousandths of an hour. All times are normal times, which is to say that values are valid for normal production and contain no additions for work (caught up on) (recovered).

How, then, are these standard data applied? The transport work to be investigated is observed and for each motion observed the proper symbol is annotated. To this the distances covered are measured and the weights moved are determined. Then in the office the corresponding standard times are read from the table and written beside the symbols. Adding these up yields the total time expenditure for the work examined. Additional MTM movements may be inserted when necessary, if, for example, a brake pedal must be activated, etc. Such transport analyses can be performed with advantage for the following purposes:

The improvement of work methods;
Comparison of manual transport labor with improved, mechanized jobs;
Comparison of two different factory layouts;
Drawing up of piecework-time-data.

The advantages in the use of such a chart consist, first of all, in the greater savings in time as against the stopwatch method, and also in that it makes little difference whether the work is actually observed, or whether it concerns a job that is first planned. The Transport-Standard-Time-Chart is thereby an effective means of the rationalizing of transport-time-studies and of transport jobs.

SIMPLIFIED RATE SETTING BASED ON MTM

By

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It is the responsibility of the foreman to see that the right number of products is manufactured, of a definite quality and cost.

This enormous responsibility has become gradually undermined by the "assistance" he receives from different staff departments. Each of these staff departments has the time to develop for one phase of his work a better technique or procedure. For instance: personnel selection, motion study, rate setting, quality control, etc. In the great majority of instances the foreman has to accept the result of work from the staff department either, because he can no longer understand the specialized techniques that have been used, or he just is not asked to judge the result. This process has greatly undermined the authority of the foreman. One way to return to him the necessary authority is to simplify the specialized techniques, so that the foreman can again accept the responsibility of saying yes or no to the proposals the staff departments make.

The purpose of this short paper is to give an impression of how rate setting can be simplified so that it can again be carried out under the responsibility of the foreman. This of course brings a number of new problems in the organization structure. To mention a few: How to be sure that the rates in the different departments are the same; What is the new duty of the time study department, etc. But these questions have little to do with MTM.

Some methods to simplify rate setting are:

A. Make the basic times as long as possible.
B. Make as few basic times as possible.
C. Make a convenient form.

A. One of the ways to simplify rate setting is to make the basic times as long as possible. This will be clear if we just look at the basic MTM card. The average time of this card is about 4/1000 of a minute. This means that in order to make a rate for an operation of one minute, the time study man has to decide 250 times which of the patterns and times he has to choose. When we make basic times of about 4/100 minute the number of decisions is reduced to 25 for an operation of one minute.

The larger the standard times the fewer decisions are necessary. There are however three factors that limit the average duration of a basic time:

1. Usefulness for method study.
2. Usefulness for instruction.
3. Accuracy of the rates.

1. Method Study

In a factory with a varied program it is generally uneconomical to make a detailed motion study of all operations. Usually the study is limited to shortening of distances and lowering of the frequencies of movements (number of stops on a sewing machine, number of strokes with a cement brush, etc.) to be profitably used for method study, these basic times should be made for one movement (one stop, one stroke, etc.).

2. Instructions

When a foreman gives an instruction on how an operation should be performed, he gives this instruction in steps (TWI), i.e., pick up one piece of material and place under the sewing machine foot. When you calculate this movement with MTM this is a complicated description, that is of interest for the MTM man but not for the foreman. So a basic time should not be larger (but also not be smaller) than is actually useful during the instruction. Otherwise the foreman will have trouble in remembering what is included in the basic time.

3. Accuracy

The ideal of a time study man is to set rates that are all accurate. Just like all other ideals this will never be accomplished. We will have to accept the fact, that economically it will be feasible only to set up a system armed at making rates which will vary slightly from the

average basic time in 1/100 min.	1 job a week					5 different jobs a week					10 different jobs a week			
	after how many min. does the work repeat?					after how many min. does the work repeat?					after how many minutes does the work repeat			
	0,5	1	2	4	10	0,5	1	2	4	10	0,5	1	2	4
1	35%	50%	70%	100%		80%	100%				100%			
4	20%	25%	35%	50%	80%	40%	60%	80%	100%		60%	80%	100%	
10	10%	15%	25%	30%	50%	25%	35%	50%	70%	100%	35%	50%	70%	100%

exact. A poll conducted by Dr. Ir. J. R. de Jong of RBB showed that a variation of a weekly wage of + and -5% with a chance of 1 : 20 that no greater variation would occur was acceptable by time study men and operators.

With this information statistical men got to work. We asked them:

How many % may the time for a really necessary movement deviate from the basic time used? If the deviation is only 1 out of 20 times greater than the following %, the rate is accurate. They had a whole list of restrictions which I will forget here.

So if we use basic times of 1/100 minute we can be 3 x less accurate in composing our basic times than if we use basic times of 1/10 min.

The required accuracy can be reached more easily by MTM than by the normal time study methods. The main reason for this is that the MTM tells why one time is different from the other. This gives the opportunity to find a much more logical grouping of all the times set as a standard for the workshop. With time study methods this grouping of the times depends on luck and on the number of data you can gather from which to draw statistical conclusions.

B. Make as few basic times as possible.

When you use the MTM table you have to select the right time from approximately 350 times that are given. A logical division of the table assists in this selecting process together with a set of rules.

I have seen in shoe factories, and also assisted in setting up books with several hundreds of basic times just for one department. You will understand that the foreman never will have enough time and energy to grasp the contents of such an avalanche of figures. So reduce as much as possible the number of basic times. Also with this reduction process MTM helps because it helps to find the main characteristic of a group of time standards.

C. Make a convenient form.

This I will not have to emphasize. To give you an idea you will find an example of how simple a form can be in this paper. This is a combination of the basic time book and the rate setting form for the sewing room for a shoe factory with many model changes.

What are the results of this simplifying process?

- In many factories the foreman actually takes part in the composition of the rates, or he is able to judge whether the rate is correctly made.
- There is a considerable reduction in the time spent in rate setting. To set a rate of 1 minute with

  a. MTM costs ca. 1000 minutes
  b. traditional basic times ca. 300 minutes
  c. with such a simplified form ca. 10 minutes.

- There are considerably less mistakes made in the rate setting.

FEATURES

Per bundle	take			4	1		
	untie			5	2		
cycle	take	1		34			
	parts	2		56	3		
	regrasp			25			
	place	1 part		45			
	under	2 parts	small	80	4		
	needle	+ align	big	104			
	MT 6.5 cm à 6.4 -				6		42
	___ cm à -						
	___ cm à -						
	tack			46	5/7		92
	turn for corner	Normal		65			
		Accurate		96			
	remove from	foot		38			
	cut threads	first		85			
		next		43			
	cut chain	1 hand		55	8		
		2 hands		77			
	cut material	first		43			
		next		23			
	Put aside	1 hand		16			
		2 hands		22			
Per bundle		bundle		13	9		
		put away		10	10		
Extra:							
RATE (min. per 10 pair)							3.57

Particulars

Operation: close heel

No:

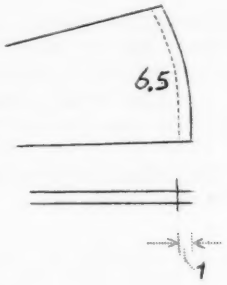
by:

date:

Model

3000 r.p.m. | 6 st/cm

Drawing:



INTRODUCING NEW METHODS

By

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Substitute of Mr. S.A. Birn

member International MTM Directorate

Although I am to talk to you on "Introducing New Methods" I would like to go one step back and discuss shortly how new methods can best be developed. In most cases your first task—after studying MTM—would probably be to use it in some way for the improvement of methods on jobs that are already in the shop. In order to show best results and savings it is best to choose a job which is done on all styles or models or where the greatest number of operators are involved (i.e., sewing lining, back seam, etc.). During the MTM training course and the following practical application period you have probably learned to see individual motions more clearly and you can spot inefficient motions immediately. To closer analyses you would subject such details as the location and position of the parts used (on table, on lap, face up or down, tips left or right or to you or away from you); also for simultaneous pick-up; whether the guide is correctly designed and working, whether to sew in chain or to cut off each piece and if so, at what point, whether you can make certain reaches while sewing, the number of stops necessary to sew a seam (try to position parts before starting to sew in order not to have to stop for repositioning); and also determine the best usable machine speed.

At this point you will probably find that you can think of several different ways how the work could be done—and this is where MTM will help you to decide which method is the best. Simply make MTM analysis of these elements for which you found alternate ways and compare the time values. Your answer will be factual and not based on opinion only. One word of caution, however, at this point. Be sure you are familiar with the quality requirements since they often affect the methods. The next step is to try the new method to be certain it is also practical and will produce parts according to specifications. An open minded instructor is best suited for this phase.

After you have found your "best method" it is important to make a record of it. You could do this in the form of a detailed MTM analysis, however, we have found this to be unnecessary mainly because it is impossible to train all people who will be involved in teaching others or controlling working methods of others. Your best approach would be to make a short description of all elements on a form similar to the one here on which you also record all pertinent information about the job itself. Be sure to describe all important details clearly enough so that they cannot be misunderstood. Use short sentences or even a "telegraphic" style. In any case leave out all unnecessary adjectives the less the instructor has to read the more time she or he has to instruct.

The next phase is the introduction of the new method in the shop. Obviously your approach depends on the nature of the change and the type of operators you work with. Major changes, such as the introduction of new or different guides, or change from one type of machine to another (i.e., from a one-needle to a two-needle or from a flatbed to a post machine) have to be taught to all operators plant-wide and at the same time the rates for wage incentives have to be adjusted. The introduction of this type of change, although it will not be accepted without some resistance, will be fairly easy. On the other hand, the comparatively small changes, such as elimination of one stop and realignment during the sewing of a seam, for instance, or the reaching to the handwheel while still sewing, or the grasping of a part so that it can be laid aside without changing the grip on it, etc., are much more difficult to handle. If you have established rates by conventional time study, the chances are that you do not even have a description of the element in question and, therefore, you cannot prove that a change has taken place and as a result the change of the rate cannot be substantiated and should not be made unless the parties involved agree.

Nevertheless, the new method should also be taught since it may result in a somewhat higher production which is desirable from both management's and labor's points of view.

When introducing new methods you will find the greatest resistance with the operators who are on the job the longest. They will first have to unlearn the accustomed method and then

begin anew with the new one. They will refuse the new method often on the strength that they do the operation faster the old way—and, of course, they are right. However, you should try to explain that after she or he becomes skilled in the new method, she will be able to earn more than before. In this stage it sometimes really does not pay to be too insistent, especially if the change does not amount to too much. However, be sure that all new operators are being taught the improved method and do not accidently pick up the wrong methods from the other operators.

THE USE OF MTM IN MAINTENANCE WORK

By

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Group D

Group D had a long but very interesting day.

As early as 8 o'clock we departed to Breda, we finally took a train back to the Hague one hour later than was planned, and many discussions had to be shortened. All this indicates that the subject was of much interest to all the group.

The subject was: The Use of MTM in Maintenance Work. We were the guest of the Hollandse Kunstzijde Ind. the H.K.I. at Breda, one of the Dutch factories of the A.K.U. concern. The program was divided into two main subjects.

In the morning we were introduced in the organization of the maintenance department, in the afternoon the subject was UMS: Universal Maintenance Standards.

After a kind reception of the General Manager, Mr. Wesenhagen, we heard of the organization of the maintenance department from Mr. van der Eyk, the Chief Engineer (350 men). The problem in this chemical industry is mostly the corrosion of all the installations and we learned how it is fought by means of new materials and methods. A large program of preventive maintenance has been set up so that incidental break downs of the installations would occur at a minimum. Each item of the program was analyzed in a considerable detail, historical data were used. Time studies had been made by two analysts for methods improvement and planning scheduling purposes. MTM was in the beginning of the application. Cost accounting and budgeting had constant attention. We had the feeling that here was a modern organization at work.

This all was the ideal situation to discuss UMS. So after the lunch, which was offered in the surroundings of Breda, Mastbos, we heard a presentation by Mr. Biel-Nielsen on the application of UMS. And from this place I want to pay credit to Mr. Nielsen on behalf of the whole group, including the staff personnel of the factory, for the excellent way in which he gave us an introduction to this new tool which has specially been developed for maintenance work and which is now installed in more than 10 factories in Sweden and Norway.

Time is too short now to repeat in some extent the lecture we had that afternoon, but I strongly advise you to read the representation of Mr. Nielsen, which is already in your map at this moment. For those of you, who do not know this development, let me tell you some items of UMS.

It is based on quite a simple idea. As maintenance work is so diverse, so irregular, so unpredictable, it is obvious that our techniques of time study were inadequate and did not succeed to do much in setting standards for this kind of work. But as the mass of the jobs was not seizable, perhaps a sample of the jobs is, so we learned from the quality control statistics. But a sample of the reality of the job actually performed, would have all the faults in methods, tools, organization, etc. So you would have wrong standards.

What the UMS plan does, is to set up a sample of jobs synthetically, a well chosen sample of jobs to be found in a certain maintenance area. They are made synthetically out of elements, and that is where MTM comes in the picture. MTM analyses, of the work to handle tools, of all elements of the work necessary to perform the job, these analyses can provide the formulas and time tables, necessary to build up the jobs, needed for the sample.

And once you have samples of all kinds of jobs actually occurred in the special maintenance field, you teach the calculator to compare the jobs that have to be calculated with the samples. They will fit in somewhere in the row of samples and you have within a certain accuracy, the standard for the new job.

Now this all is not so simple as I am able to tell you here; it is also not my intention to explain it, I think you should rather read the article.

But I am pretty sure that the idea behind the UMS system will prove to be the solution to many calculating problems, not only for maintenance work, but also for many other non-repetitive and diverse work.

And I strongly believe that it shall be on the long run in such programs that predetermined time systems will show their greatest contribution to the industrial engineering and management.

UNIVERSAL MAINTENANCE STANDARDS

By

H. E. Biel-Nielsen

North European Operations Svenska A.B. N.E.C.

Göteborg, Sweden

INTRODUCTION

The background for the development of the UMS system is the continually increasing costs of maintenance and repair work. An important factor has also been the great difficulties facing management when trying to gain control of efficiency and quality.

Industrial management has for long known the need of more effective organization, objective measurement and systematic control of maintenance work. On the other hand, we have been missing industrial engineering techniques which could solve the problem of measurement in an economic way.

H. B. Maynard and Company developed the UMS approach in order to meet these demands and at the same time satisfy the skilled worker's demand for incentive rates on maintenance work.

1. Definition.

UMS is an abbreviation of

Universal Maintenance Standards

The word maintenance covers in this connection the following areas of activity:

a. Preventive maintenance
b. Repair work and overhaul
c. Installation and construction work.

2. Fields of application for the UMS system.

With the UMS approach we can cover most of the various trade groups which are usually connected with maintenance work in industry. That is:

a. Electrical maintenance
b. Mechanical maintenance
c. Pipe fitting and plate shop work
d. Building maintenance.

The maintenance work in the various industries are very much alike regardless of type of industry. So it is fully possible to apply the UMS technique to any kind of industry, from paper mills to metal working industries. Our experience justifies this statement. On the other hand, one must understand that it will be necessary to make modifications and some changes in approach from industry to industry or even from company to company within the same industry. To accomplish a fully effective installation it will be necessary to "tailor" the UMS installation to meet the individual companies actual conditions and problems.

THE PROBLEM OF MAINTENANCE IN INDUSTRY

1. The Industrial Development.

From the very start of industry we have had a steady trend:

Piece production to mass production

At the same time there has been a parallel development of the operations and processes which to a great extent has been the basis for the industrial development:

Manual work → Mechanization → Automation

This development has shown great economic advantages for society but has at the same time created problems. One of the greater problems has been the movement of labor from direct productive operations over to material handling and control of processes, and further on to manufacturing of machines and tools which in turn has demanded more workers in maintenance and repair work.

This trend has resulted in a steady increase of maintenance workers within industry. This trend is especially strong when one compares the number of maintenance workers per 1000 direct production workers.

Du Pont in USA has publicized an investigation of the development within 79 factories within the concern. The results of this survey have shown that the number of maintenance personnel has increased 150% from 1940 to 1955. The increase in production workers during the same period was only 25%.

Such a heavy increase must, sooner or later, show its influence in the labor market.

The demand for qualified and skilled maintenance workers will in the long run have a tendency to exceed the supply.

2. Cost Problems.

Industrial management is also beginning to realize that the costs of maintenance represents a heavy part of the total operating costs. Not only that, but it is a cost exceedingly difficult to control. It should be clarified that we actually deal with two separate but connected cost problems:

a. The cost of maintenance show a steadily increasing trend and it covers an increasingly larger share of the total production costs.

b. Breakdowns in production equipment and machinery will more seriously affect operating costs as entire lines or processes must stop producing. This is the price we have to pay for increased mechanization and automation in industry.

Let us just shortly review how breakdowns influences production as compared to the effectiveness and quality of maintenance. Let us as an example see what automation means to an average production unit. Let us assume that a production unit consists of fifty individual machine units connected in a transfer line. If every machine on the average stopped 2% of the time due to repair work or breakdowns this does not mean too much to production before we introduced automation. The whole production unit would have been able to produce theoretically at least about 98% of the total available time. But after the introduction of automation we have changed this picture radically. With the same machine units availability of 98% we will now be able to produce 40% of the total available time. If the machine availability on each individual machine decreased to 90% we would certainly be completely out of luck because now production would go down to 0. In order to have this automotized unit producing 90% of the time it will be necessary to maintain an individual machine availability of 99.8%. This figure certainly indicates the tremendously increased demand on better and more maintenance.

3. Wage Payment of Maintenance Workers.

The last years industrial development has also created problems of wage payment from the maintenance workers viewpoint. In most cases the increase in the skilled workers wages have not followed steadily rising wages paid to the production workers on incentive work. Management has not had any measured basis for granting pay increases to maintenance workers. In production the workers have been paid according to their performance. No such thing has been possible in the maintenance field.

During the 20 to 30 years we have succeeded in gaining rather good control of the direct production labor cost. One way has been to introduce process controlled operations. Another way has been through systematic work study which has enabled us to base the wage payment upon objective measurement of performance. Objective measurement is the only satisfactory basis for sound incentive rates and thereby for sound wage increase potential for the workers.

In the field of maintenance management has certainly been hesitant of paying higher wages without getting any guarantee of an increase in worker productivity. Management has frequently selected to hold the line through day-work pay, even if this in the long run might mean less effective maintenance.

The net result of this development is that the income potential has been less and less appealing to workers. This has in several areas had a negative influence on the supply of qualified maintenance workers.

4. Industrial Engineering and Maintenance Work.

Now we may ask why we have not used the old and well known techniques of work study to arrive at a sound basis for work standards? These techniques have been successful in most other areas of production.

The basic objectives of industrial engineering looks exactly like what we need within maintenance:

to develop more effective methods

to determine consistent standards times through objective measurement.

The work study techniques have certainly been developed very much during the last 10-20 years. One reason being that they simply had to take care of the many problems caused by the redistribution of the labor force. Unfortunately before UMS this development of techniques had not succeeded in creating any technique which would be economical to apply to maintenance work.

The great drawback, when it came to standard setting on maintenance work, has been the very great costs involved in standard setting.

Maintenance work consists of a vast number of different tasks and operations all carried out at a rather low frequency. To set standards on such work by the application of time study can not be considered economical. Such an approach should require one time study man for every two to three workers if we want to obtain a reasonably satisfactory coverage of the maintenance activities and time. Tables with standard data or time formulas would give a somewhat better solution to the problem but it would still take too long to compute and apply these standard times. It is correct that MTM, to a great degree, has minimized the time necessary to set up standard data and time formulas and as such would provide a step in the right direction. But the step from the standard data table values and the final standard time ready for application would still be too costly. A rate applicator well equipped with standard data and time formula tables would only be able to determine incentives for relatively few maintenance workers per day.

Now we may ask what is it which makes maintenance work so different from other kinds of work and difficult to handle from an industrial engineering viewpoint? In order to answer that question let us analyze a few of the characteristics of maintenance work from a work study viewpoint:

a. Maintenance work is to a large extent not repetitive work. Every job represents a new combination of a very great number of work elements.

b. Even the work conditions from each individual job or work element will vary somewhat from time to time.

c. We can very seldom determine all the details of a new job in advance.

d. The maintenance activities cover a vast and greatly varying field of plant facilities, from the change of light bulbs to the overhaul of a paper machine, from the lubrication of motors to inspection of electric furnaces.

e. In maintenance we meet great organizational difficulties due to the many different trades involved. Other problems are the great transport distances, the urgent repair jobs, and the possibility for varying size of work teams.

A very thorough analysis of these characteristics led to the conclusion that an entirely new approach was necessary. And this realization caused the development of what we here present as the UMS system.

Throughout all past years we have tried to find a way which would give us pretty exact standard times for the various maintenance jobs. We have actually tried to apply the same approach which we would use when we determine standard times for repetitive production work. So we have tried to adopt the production principles of motion patterns and precise standard times to maintenance tasks. In other words, we have tried to obtain standard times which would represent the exact time which a qualified maintenance worker would use to carry out each individual job element.

The UMS plan recognizes the fallacy in this approach. The nature of maintenance work is such that it is unrealistic to expect every maintenance worker to do a given job with exactly the same motion pattern in exactly the same time. The varying condition to the work alone would prevent this. Practical maintenance men for years have asked industrial engineers: "How can you set a standard that will be fair for, say, a pipe repair job when you cannot tell in advance how badly the pipe will be rusted?"

The answer to this obviously is, "you can't, that is you can not set a standard that will be accurate for each individual job."

In addition to the changing working conditions there is another variable which will make it very impractical to try to achieve individual standard times. This important variable concerns the method which the worker will use. In maintenance work it is impossible to describe the method motion by motion in advance as we can do it in repetitive production work. On the contrary it is both realistic as well as practical to let the workers themselves determine to great extent the best possible approach to each individual task. This certainly requires that he is both qualified and trained to go through such a thinking process.

Instead of trying to obtain the impossible, that is, to determine exact standard times for each individual job, we have developed an approach whereby the statistical distribution of the various tasks and the task times will work to our advantage. We will develop standard time values which will give the correct total result for the sum of jobs and tasks which will be carried out for a certain period of time such as one or two weeks. This has become possible through application of the principles of statistical

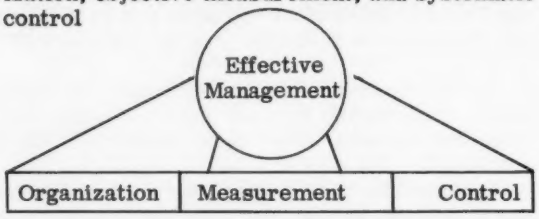
distribution and balance of errors. It has enabled us to simplify the rate setting of the individual maintenance job to the point where one rate applicator can economically set standards for a large group of workers.

Once we have clearly understood these basic principles and have succeeded in setting up these average standard times, then we will have a good basis for sound incentive rates. The whole concept is simple and is the key to the solution for standard setting on maintenance work. But to set up the system is still a rather complicated task. One can not expect to be successful with a haphazard approach or by trying to cut corners in arriving at the basic data. The foundation has to be sound or the whole building will topple.

WHY DO WE WANT TIME STANDARDS ON MAINTENANCE WORK?

1. The Principles of Effective Management.

A main principle for modern and economic operation of industry is that management to be effective must be based upon an effective organization, objective measurement, and systematic control



Management of maintenance is no exception to this rule. Unfortunately as long as we do not have objective measurement the management activity is doomed to be rather ineffective.

The purpose of the objective measurement is to arrive at standard times which are based upon how the work should be carried out and not upon how it is done today or how it was done previously.

The standard times will also provide the basis for:

a. An economic development of better methods.
b. A systematic planning and control of maintenance work.
c. Wage payment in accordance with work performance.

2. Standard Times as the Basis for the Organization of Maintenance.

We even find that the maintenance organization itself will be influenced to a great extent by the knowledge of the standard times. They will help us to find the answers to questions like these:

How big should the work teams be?

Should the company have centralized or decentralized maintenance units?

Where should we place the spare part stores?

What job procedures and tool kits should we use?

How great a part of the repair jobs should be subcontracted to outside maintenance firms?

From these very simple questions we can see that there are a number of unsolved or difficult problems within maintenance. It is like a catalyst for improvements have been missing. If we look at certain basic factors of maintenance we find immediately how little has been done about this field of activity:

Maintenance organization	is often under-developed or lacks clear definition.
Methods development	through studies, measurement, and analysis has not been carried out to any greater extent.
Objective measurement	has not been economical to carry out.
Training & Instruction	of the skilled workers has most often been limited to the standard apprentice training.
Planning & Control	of this maintenance operations and their costs have only just started in the more progressive industries.

It has been found that once we have determined the proper UMS standard times then we have succeeded in getting this catalyst which would initiate sound improvements in each one of the above factors.

THE APPROACH IN THE UMS SYSTEM

1. Factors Which are Influenced Through UMS.

The UMS system is frequently referred to as an incentive system for maintenance work or as an industrial engineering technique comparable to MTM. It is neither.

The installation of UMS can be carried out with or without any application of incentive rates. The standard setting techniques of UMS will provide time standards. If we in addition to this can determine a satisfactory wage payment system acceptable to the workers then these standard times can certainly be used for the determination of fair and consistent incentive rates. On the other hand to consider the UMS system as another work study technique is also completely erroneous. It can lead to serious consequences if we just try to set rates without giving any consideration to anyone of the other important factors of methods organization and planning. Actually most of the other well known work study techniques such as, time study, work sampling, MTM, will be used in the re-organization process involved when we install UMS.

The installation of the UMS system must be based upon the systematic development and improvement of the work organization, methods, standard times, worker instruction, as well as planning and control of the maintenance activities.

The following table will give a short review over some of the factors which generally must be considered whenever we introduce UMS:

Maintenance Organization

a. Centralized or de-centralized
b. Organization of work teams
c. Coordination of supervision
d. Control of material supplies spare parts and tools.

Work Methods

a. Preventive maintenance
b. Transportation of spare parts and tools
c. Tool standardization
d. Work procedure
e. Proper tool application

Time Standards

a. Transportation time
b. Job preparation time
c. Production time

Job Instruction

a. Training in the use of tools and job procedure
b. Task instruction
c. Information about rate setting and payment
d. Selection and training of supervision
e. Re-schooling of workers.

Planning Control

a. Work order system
b. Job scheduling and dispatching
c. Control of performance
d. Budget and cost control
e. Repair statistics.

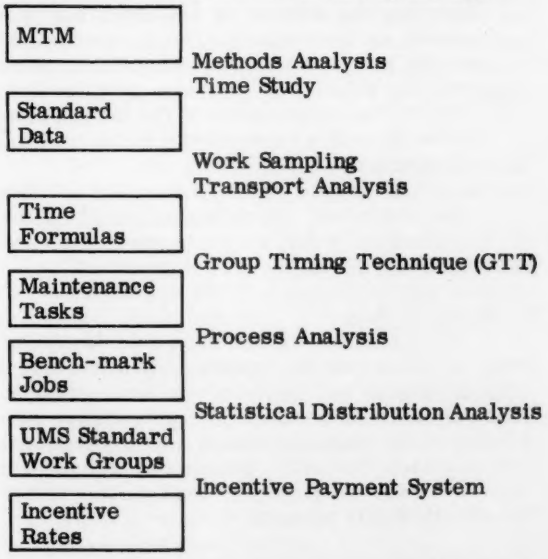
The two central factors which contains the key to the whole complexity of problems are:

THE FACTORS OF METHODS AND TIME

To arrive at any clear determination of these two factors by studying actual repair jobs does not get us very far. We would only obtain vast piles of data which would indicate great variations and lack of consequence. In order to create data which can be made subject to systematic analysis and application, we have to start at the very beginning and build up each individual job element through the building block method. That is through a nearly pure synthesis. It is interesting to note that this synthesis in many ways corresponds to the historical development of the application of the MTM technique.

2. The UMS Synthesis.

The following picture shows the development one has to go through to arrive at what is known as the UMS standard work groupings.



A very strong development of the MTM technique has taken place during the last 10 years. One essential feature is that the MTM technique has been reinforced by the inclusion of many of the previous work study techniques.

This is clearly indicated in the above picture where many previously known techniques will have to be incorporated in order to arrive at the final results.

Let us briefly describe the various steps in this chain which leads us to the final UMS standard work groupings.

3. The MTM Technique.

The Methods-Time-Measurement procedure may be defined as follows:

> MTM is a procedure which analyzes any manual operation into the basic motions required to perform it and assigns to each motion a predetermined time standard.

So MTM determines the standard time for a job as a function of the method followed. When we use MTM in developing standard data we gain several benefits:

a. We can carefully define the method which should be followed for example in the use of a hand tool. We can do this through observation or visualization which will enable us to make a careful analysis which in most cases will lead us to methods improvements.
b. The time for each work element is determined by the MTM time data at the same time as the method is defined. This will enable us to compare different methods in order to arrive at the more economical one.
c. The written description of the method provides us with a valuable tool for instruction of workers.

An important psychological point in the MTM technique is that we study the method and not the worker.

4. Standard Data.

The principle of standard data developed from MTM is easy to comprehend. It is a more difficult task to arrive at correct standard data. First of all it is necessary to give a clear recording of the work conditions for each standard data element. Secondly, we must insure proper balance in the frequency of each motion within the standard data element.

The standard data technique gives us several advantages:

a. The standard time for a job can be computed considerably faster with standard data than with the basic MTM data.
b. It will naturally lead us to a standardization of tools and operations which can be of great benefit in maintenance work.

In maintenance work it will be quicker to apply standard data than time study but on the other hand we have still not arrived at a satisfactory economical solution.

5. Time Formulas.

The next step we take is to organize our standard data into time formulas. The time formula provides us with a relatively simple and systematic treatment of both variable and constant factors. This will eliminate a lot of repetitious analysis work which we would have had to go through when applying standard data. The time formula derivation involves more engineering time in the development stage. But it gives us a much greater time reduction in the application stage. When we have analyzed a maintenance task or job after it has been performed we can apply the time formulas. This will give us the standard time for the maintenance task and do it quickly and accurately, that is within satisfactory tolerance limit. But to determine the standard time before the job is performed with time formulas will still have some serious limitations.

6. Tasks and Bench Mark Jobs.

In the time formulas we have an analysis technique which can be applied quickly as soon as the maintenance job is performed and all the tasks are known. To use them for the daily task of establishing standards, however, where an individual standard would be computed for each job would be time consuming and impractical. There are just too many standards to set.

So instead we will use the time formulas to determine the time for a number of representative maintenance jobs which we will call bench mark jobs. It will also be practical to determine proper standard times for a number of smaller job units which we call bench mark tasks. One job will normally consist of several tasks. The bench mark jobs and tasks are derived by studying a number of actual maintenance jobs. Each job will be studied as it is actually carried out but will be subject to a careful reanalysis in order to determine what the proper method should have been, what tools should have been used, etc. When we have thus established how the job should properly have been carried out we can apply our time formulas to determine our standard time and we have arrived at a bench mark job standard.

It is obviously necessary to select the

bench mark jobs in such a way that we cover a satisfactory range of maintenance jobs.

The important concept is that the bench mark jobs and tasks as well as their standard times, are based on proper procedures, new methods and standardized tools. So we have through methods synthesis established how the job should be carried out, not how it was done in the past.

One misconception has been that the time formulas should be universally applicable. That is true in some cases but in most cases the formulas must be modified and adjusted to meet the conditions, procedures, and tooling which is used in the individual industry. To believe that we can take one set of formulas from a different industry and apply it directly to our own maintenance work will only lead to serious mistakes and in the long run could seriously affect the confidence in the whole procedure.

It is good to remember that we are dealing with other human beings work and income and that can certainly not be treated lightly.

7. Standard Work Groupings.

The standard work groupings represents ranges of times. We usually codify the various work groups with capital letters A, B, C, D, etc. Each letter then represents a time group within defined time limits. The letter C, for example, can represent all jobs within the time limits of .8 hour to. 4 hour. The total sum of all the groups can for example represent the time from 0 to 24 hours divided up into the standard work groups A, B, C, D, etc.

The conclusion from our discussion of maintenance work characteristics is that instead of trying to set individual standards of pinpoint accuracy it is more practical to set standards based upon the range of time in which a given job would probably be done by a qualified man. In effect we can in advance determine with a great degree of probability that a qualified worker will do a given job in say 40 to 60 minutes and be right 99 times out of 100. In order to do this we must have a clear concept of when a given job will fall within the specified time group. This is where we use our bench mark jobs. Within each work grouping we will place an adequate number of representative bench mark jobs. This will enable a rate applicator to set a standard on a new job by a systematic comparison with the bench mark jobs within the individual standard work groups.

The classes in time ranges might be different from installation to installation because of different conditions. The principles followed in establishing standard work groupings is that the intervals or ranges should be sufficiently long so that it will not be difficult to place a given job in its proper classification and yet short enough so that this method of measuring performance is reasonably accurate over a weeks period.

8. Determination of Standard Times.

A new job coming in to the rate applicator can now be determined through the comparison with the bench mark job or through a combination of individual tasks.

The task of the rate applicator is to take the requisitions that come to him for maintenance work and place them in the proper work group. He does not attempt to say exactly how long it will take to do a given job. He merely says that it will take for example from .8 to 1.4 hour to do a particular job so he places the requisition in group B. It is impractical to assign a range of time as a standard, so he uses the average of the range. For a class D job, the time value assigned would be 1.1 hour.

When our base material is properly developed it will be subject to the principles of normal statistical distribution and probability. When an adequate number of jobs are added together over one or two weeks time then the sum of standard times will very closely represent the actual time taken by a qualified maintenance man working at normal performance level.

The time tolerances on this sum of work will be fully adequate to use as the basis for straight incentive pay.

The time values will obviously represent the work method which a skilled worker properly trained would use.

9. Difficult Maintenance Jobs.

From time to time the rate applicator will receive job requisitions which can not be classified in the above manner. This could be due to several reasons:

a. That a similar type of work has never been performed before.
b. That the job itself is not represented amongst the bench mark jobs.
c. That the elements of the job can not be determined in beforehand.
d. That the job involves especially difficult conditions.

There are several ways in which we can handle these problems. Let us mention a few:

a. We can go back to our basic time formulas or maybe even standard data in order to determine the time.
b. The job may be divided up in several steps and we can apply standard times to each individual step.
c. We can arrive at the job by combining several different bench mark jobs or elements out of previous bench mark jobs.
d. The elements of the jobs can be registered as they are carried out. This way it will be possible to set the whole standard after the job has been performed. The key point is that the standard times were actually determined before the job was carried out but could not be applied until we knew what elements were involved in the job.
e. Finally we have to recognize that there will always be a certain percentage of jobs which we cannot handle due to the inherent difficulties. We can normally say that this per cent will not exceed 10 to 15% of the total job time involved in maintenance work.

CONDITIONS FOR THE APPLICATION OF THE UMS SYSTEM

There are five factors which we have found to be essential to an UMS installation. These are:

1. Proper organization of the maintenance work.
2. Properly developed time standards for the maintenance jobs.
3. The maintenance personnel must be equipped with the proper tools and be well informed and instructed.
4. An adequate number of well qualified and trained personnel for application of rates.
5. The introduction and installation of the system should be carried out in close cooperation with management, supervisors and workers.

These points indicate the need for proper follow-up and adjustments of all factors which are not in accordance with the pre-planned conditions. The rate applicator must not only know all his basic data, he must also be fully familiar with all the different kinds of maintenance jobs. We must actually require that he himself has a good foundation of practical maintenance experience because he will often have to visualize what is going to happen before he can set a standard on a specific job.

An important rule of management is that if you delegate you must train. The selection of the proper work method will in most cases have to be made by the worker himself. So he should be fully familiar with the best procedure and the method he is supposed to follow in order for him to meet and better his standard time. So we must provide him with adequate information and training. He should also fully understand the whole incentive wage plan so that he has confidence in his own ability to get a satisfactory income.

It is fundamental for the whole plan that we create this greater productivity by organizing the work more effectively through better methods and tools and by planning the jobs more carefully. The idea is not to achieve a higher productivity through pressing the workers through higher individual performance.

Very great benefits will be derived by proper planning and control of the maintenance work. But without introducing an incentive wage payment plan we have not really solved one of the fundamental problems which was a satisfactory payment of the skilled workers. So the last step in our development should be to set up a payment plan which can eliminate the present dissatisfaction when the skilled worker compares himself with the production incentive worker.

Only this way can we hope to create a more fair and consistent payment system throughout an industrial plant.

The incentive payment plan can be designed in quite a number of different ways. We can set up anything from a straight incentive plan to the pure measured day work system. The standards can be applied as group standards or be used for individual worker pay. There is no such a thing as a best system because conditions will vary from place to place. The essential principle is that we through UMS have been enabled to pay the maintenance worker in direct relation to his job performance.

PRACTICAL RESULTS OF UMS INSTALLATIONS

What has now been the practical results of UMS installations? There has been not one but several important results.

1. The UMS installations supported by proper reorganization of maintenance have generally resulted in productivity increases from 60 to 100%.

2. The maintenance workers income potential has generally been greatly improved.
3. Management has been able to gain a satisfactory amount of control over the maintenance costs.
4. For the first time it has been economically feasible to measure and control maintenance work in relatively small industries or in big industries with small maintenance groups.
5. By increasing the productivity of the maintenance departments they have been enabled to provide both better maintenance and meet the greater demands of mechanization and automation. The increased capacity can even be used to reduce construction or installation work previously provided by outside contractors.
6. The greater capacity as well as the strong emphasis on more preventive maintenance have a strong tendency to reduce machine breakdowns.

With strong trends toward more and more automation we know that the necessary capacity of maintenance will have to be increased considerably to meet all these new demands. Management in nearly all industries are today faced with growing competition and diminishing profit margin. Maintenance has at the same time evolved into a cost factor which can seriously influence the competitiveness of an industry. It is necessary that management in its long-range planning will recognize the need for more effective maintenance at less cost.

In order to reach the very desireable objectives we have set up for UMS installations it will be necessary to apply careful planning and skillful action. We are not dealing with an easy and uncomplicated work study task. On the contrary, in the maintenance field we will have to apply the same systematic integration and coordination of modern management which we already are familiar with in the production area. We will need good management, skillful organization, good human relations, and advanced techniques of industrial engineering. When management fully recognizes and supports these ideas only then do we have the full opportunity of utilizing the great potential inherent in present day maintenance work.

APPLICATION OF M. T. P.

By

A. H. M. Langezaal

Unilever N. V. Rotterdam

1. General

MTP is an abbreviated description of the structural elements to be dealt with in this report, viz:

- MTM elements
- task elements
- production elements

The reason for creating MTP is the possibility provided by the application of MTM. Let us assume that in a certain enterprise an MTM analysis has to be made of the wrapping and sealing of a packet. In drawing up the analysis certain variables are encountered which being localized provide the possibility of simultaneously determining the analysis and time values of the wrapping and sealing of larger, broader, taller, etc., packets. These time values apply only if the same standard conditions are maintained as laid down in the analysis.

These standard conditions will not always be and remain the same at the same job location thus necessitating adaptation of the analysis. The same action can also take place in other localities, departments or factories where the analysis already prepared can be utilized, provided the standard conditions correspond.

As this is not always the case it has been found in practice that either the standard conditions have to be adapted or the analysis modified.

As a rule it is not possible to adapt the standard conditions because the job location has been arranged with view to the total work that takes place, of which the wrapping and sealing, for instance, is a component part. It will then be necessary to modify the analysis. On account of the multitude of information contained in the analysis and the changes that have to be made, as a result of which it is necessary to rewrite the analysis and to recalculate the formulae, the amount of time saved is slight.

The advantage of the similarity of the analysis and consequently in the task setting remains. It has been found that when the analysis is broken down into smaller elements which are indicated together with their influence factors, the build-up with the variables of the smaller elements takes the place of modification of the complete analysis.

It has also been found that certain elements, notably Reach and Move between the actions, depend largely on the standard conditions. By keeping the Reaches and Moves separate and applying them separately a large number of variables is eliminated in the build-up with smaller pieces. The method of distributing the complete analysis, the codification of its parts, operations, part operations and task elements, the presentation and the method of build-up is covered by MTP.

2. Analysis and Subdivision

The object of subdivision is to combine as many elements as possible and the variables and standard conditions belonging to them. A complete analysis which on account of its presentation and the indication of the variables is and remains representative will always be preferred.

The complete analysis proceeds from MTM basic elements, the variables are determined and the build-up is presented with formulae and tables. Although the number of variations may be considerable, other variations may occur in the components that are not analyzed, the sequence of the components may be different, whilst on account of the location, etc., certain standard conditions have been changed. If all these variations were provided for them the tables and formulae would be so large as to be illegible.

3. Relation Task Element—Part Operation—Operation

3.1. Task Element

The task element is a combination of MTM movement elements but confined to a Grasp and Position or one operation.

An MTM movement is at the same time also a task element although its presentation is superfluous, since everyone working with MTP should possess basic MTM knowledge.

Among Grasp and Position, variations occur that are not indicated on the table chart, e.g.:

- grasping with sliding, with handling, with turning, with counting off, etc.
- positioning likewise with sliding, turning, tilting, etc., also one-sided or two-sided positioning possibly against a stop, and with varying play in the ultimate destination.

The analysis with sketches of the task elements may be regarded as an extension of the MTM table chart with special Grasps, Positions and Handlings.

A preceding Reach or a Move following upon Grasp is not included in the analysis of the respective task elements. Nor does the respective task element show a preceding Move and a Reach following Position. In a Handling those Reaches or Moves are included in so far as they coincide with the carrying out of the handling. Thus the other limit of the task element is set.

3.2. Part Operation

A combination of task elements possibly supplemented by MTM basic elements is a part operation or production element. The limit of a part operation on the one hand has already been laid down by the limit of the task element. The other limit of a part operation is its general applicability. If in connection with fixed standard conditions an entire operation can be determined by means of influence factors then this part operation is at the same time an operation.

However, normally a part operation is a part of the entire operation, such as taking adhesive strip and placing same, wrapping a parcel, etc. As in the case of the task elements the Reach and/or Move preceding or following a part operation is not included in the analysis.

8. Code (General)

8.1. Task Elements

Task elements are split into:

1. Reach—Move—Turn (Body)—Walk	R—M—TWR/TWM
2. Grasp	G
3. Position	P
4. Handling	H

Task elements are grouped whenever possible among code G or P. After this the task elements will be grouped under code H. With the exception of the group handling the TMU value of the MTM analysis is entered in order to complement the code. Where several values are possible, the lowest figure is used in the table for the code; this is done to obviate an unnecessary large number of MTM analysis sheets.

With the group handling more differentiation is necessary. In order to collect task elements of the same kind together the following rules are employed:

The H is followed by a figure that can range from 1 to 9. These figures have the following meanings, depending on the nature of the operation.

Description	Abbreviated explanation
1. Forming	The hands are directed in space when forming.
2. Structural change	The structure of the material is changed by the operation.
3. Surface treatment	The operation medium is guided through the surface.
4. Transporting	Displacement of objects.
5. Combining, positioning, closing	Accurately determining the destination of one object in relation to the other.
6. Closing, opening, separating	Breaking the contact between one object and the other.
7. Checking and sorting, searching	The sense perception is in part limiting; comparing, deciding, choosing are other possibilities.
8. Reading and speaking	The visual perception is limiting. This also applies to speaking.
9. Arithmetical operations	These include mental arithmetic, figure work, etc.

After the H and a figure from the group 1 to 9 there follows a letter, viz. an S, E, K, P, F, L, or G. These letters have the following meanings:

S = solid
E = elastic
K = kneadable
P = pliable
F = fragile
L = liquid
G = gas

After the figures, with the exception of 5 and 6, the TMU value of the analysis of the table is used in code form just as with the other groups R—M—TWR—TWM, G and P. With figures 5 and 6 there are always two objects. Hence, for both objects a further indication consisting the characteristics of these objects is given by means of the same letters S, E, K, P, F, L and G. After the two letters found a TMU value follows as a further codification.

Survey of the Code

8.2. Part Operations

For this code the reader is preferred to the code for the classification of movement patterns of parts thereof which is attached as an appendix.

8.3. Note on Code

The code is drawn up in such a way that analysis of the most divergent operations can be filed away and recovered.

For local use this extensive code can be a disadvantage. It is of course possible to use this code only for looking up. Locally a different classification and codification can be applied to the tables drawn up, according to the prevailing practice in the factory in question. This does not necessitate changing the files in question.

Group	Nature of the operation	Characteristic of object in hand	Characteristic of other object (only after 5 or 6)	TMU value
R-W-TWR-TWM G P H	1,2,3,4,5,6,7, 8,9	S,E,K,P,F,L,G	S,E,K,P,F,L,G	Dependent on MTM analysis

ACTIVITIES OF THE TEXTILE WORK-TEAM OF THE NETHERLANDS MTM SOCIETY

By

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The textile-work-team started its meetings in 1956. These meetings, which on an average are attended by 6 to 10 members, are being held 9 or 10 times a year. The participants are from different textile industries. The work-team reports to the Technical Committee of the Society on its activities.

The aim of these meetings is threefold, viz.:

- Exchange of experiences, for instance by a collective discussion of a special problem, preferably of current interest, with which one of the members is faced in the application of MTM.
- Research in the field of textile subjects of general interest.
- Maintaining the quality level.

In the course of time various items have been discussed. The subjects may be classified, according to their nature and way of treatment, as follows:

a) Comparison between the analyses of one specific manipulation, made by the different participants.

b) Discussion of incidental analyses of one of the participants.

c) Discussion of general aspects of the use of MTM.

d) Compilation of standard analysis for operations which occur in practically all branches of the textile industry.

a) A comparison of analyses has a.o. been made for the manipulation of bobbin change in the winding department.

This has already been discussed at a previous congress (see G. H. Vloedbeld: Co-operation of Plants in work study on the basis of MTM-data; MTM Journal, Vol. V, Nr. 1,2 dated 1958).

b) In the discussion of incidental analyses of the participants the usefulness of criticism becomes evident: difficult parts of movement-patterns become better formulated and factors influencing execution and time are placed in a new light. It has happened that one of the participants was working on a problem which he thought was specific to his own plant. However, discussion of the problem produced suggestions from other participants who had encountered a similar problem and had found a solution.

In this way the following subjects have, amongst others, been discussed:

- piece-up of ends down in the spinning department (wool)
- packing of piece-goods
- setting of drop wires in the weaving department
- feeding of wool into the carded yarn spinning department.

c) As far as the general aspects of MTM are concerned, one of the participants gave an

introduction on the conditions that must be fulfilled to obtain the most effective use of MTM in textile operations. This gave rise to an extensive exchange of thoughts on the level of skill which may be considered normal in the textile industry.

Another introduction dealt with the differences between various systems of work-analysis, which subject has also been discussed already at the last congress. In connection therewith a comparison was made for the winding department between the different allowances which are given by the participants on the times determined by MTM in order to arrive at a standard time.

The ultimate differences between the results were small and the study gave a clear insight into the aim which is being pursued by every participant when making a movement-pattern.

d) Standard analyses were compiled by the work-team for the manipulations of "picking up the thread" and "knotting," generally occurring in textile mills.

A report was issued on the analysis of some 8 knots, in which at the same time the situations, to which these analyses apply, where described.

Since it has been the experience of the work-team that with such a movement-pattern, where finger-movement plays a large role, it is difficult to interpret the MTM-analyses in spite of a correct description, the analyses were illustrated with diagrams. After completion of the report the participants jointly discussed to what extent they had been able to make use of the analyses individually.

The analyses of the knotting manipulation were used for:

- a comparison with existing analyses of their own;
- information to the supervisors in which primarily the qualitative advantages of one knot as compared with another were stressed.
- a comparison with the movement-patterns, used in actual practice, for the sake of instruction purposes.

A remarkable thing is, that in general the manipulation of knotting is done more cunningly in the wool industry (Brabant) than in the cotton industry. In all probability this is due to the fact that the frequency of this manipulation is higher in the wool industry.

This was briefly a summary of the nature of the activities of the textile work-team during the past years. In spite of the fact that the team is not homogenous enough to make a complete survey of different operations, the participants are of the opinion that the meetings are sufficiently useful to continue them.

Mr. H. P. Bakkenes speech by

Normen voor Kantoorarbeid

will be published

in the next Journal

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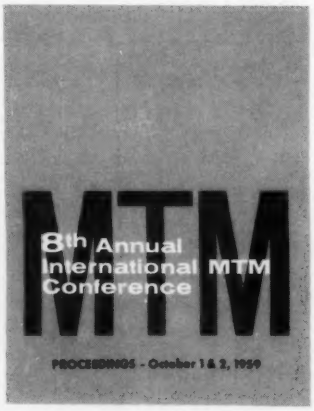

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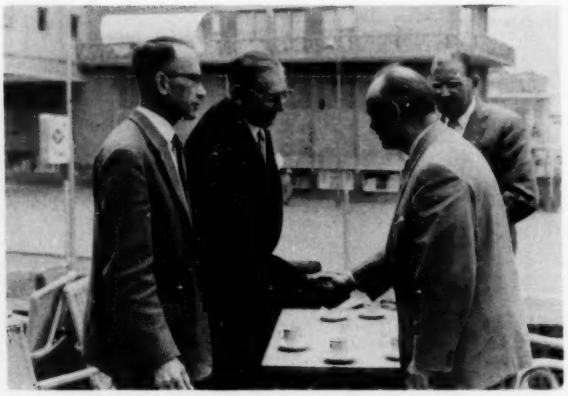
INTERNATIONAL CONFERENCE AND DIRECTORATE MEETINGS

Opening speech of Mr. Volz:
From left to right: Messrs. H. Bohlin; Gerh. H. P. Veldkamp, ir P. A. G. Volkers, H. F. Miedema (three board members of the Nederlands-MTM-Genootschap).

Shows the members of the board of the Nederlands-MTM-Genootschap and the presidents of the sister-associations applauding Mr. Bohlin's speech. From left to right: Messrs. Gerh. H. P. Veldkamp, ir P. A. G. Volkers, H. F. Miedema, H. vande Bunt, ir R. F. Volz, S. Hassel (Norway), R. Soumagnac (France), W. Hebeisen (Switzerland), Prof. D. W. Karger (USA), and ir W. B. Rueb (Holland).

In the first row: From left to right: Prof. Daenzer and Mr. Volz; in the second row from left to right: Messrs. Rueb, Lapoirie and Martz; in the third row from left to right: Messrs. Bohlin and Farr.



At the right (with spectacles) Mr. Langenberg, Secretary of the Committee of Preparation. At the left shaking hands with Prof. Daenzer is Mr. Kossen, member of the Committee of Preparation. Mr. H. W. Berenschot, member of the Committee of Preparation, is on the left also.

All members at the "Rotonde' Zandvoort-on-sea before the lunch.

Left to right: Messrs. Rueb and Volz arriving at the "Rotonde" Zandvoort-on-sea.

AND DIRECTORATE MEETINGS

At the front of the table: Mr. Volz (Holland).
From left to right: Prof. W. Daenzer (Switzerland); Mr. Martz (Switzerland); Mr. W. B. Rueb (Holland); Mr. H. Bohlin (Sweden); Mr. G. Lapoirie (France); Mr. Chas. Strommenger (representing Mr. S. A. Birn, USA); D. E. Farr (USA).

At the left shaking hands with Mr. Martz is Mr. H. van de Bunt, Treasurer of the Nederlands-MTM-Genootschap.

Mr. G. Lapoirie

Messrs. D. E. Farr and R. F. Volz.

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RESEARCH REPORTS

R.R. 101 Disengage

This report contains a preliminary study of the element disengage. While it is still classified as tentative, the report contains some extremely interesting conclusions on the nature and theory of this element.

R.R. 102 Reading Operations

The first step in the use of MTM for establishing reading time standards is contained in this report. In addition, the report contains a synopsis of the work done in this field by 11 leading authorities.

R.R. 104 MTM Analysis of Performance Rating Systems

A talk presented at the SAM-ASME Time and Motion Study Conference, April 1952. It contains an analysis of performance rating systems and various performance Rating Films from an MTM standpoint.

R.R. 105 Simultaneous Motions

This report represents almost two man-year's work on a study of Simultaneous Motions. It is a final report of the Simultaneous Motions project undertaken by the MTM Association. While it does not purport to provide complete and exhaustive answers to all problems in the field of Simultaneous Motions, it presents a great deal of new and valuable information which should be of interest to every MTM practitioner.

R.R. 106 Short Reaches and Moves

This report contains an analysis of the characteristics of Reaches and Moves at very short distances. It develops important conclusions concerning the application of MTM to operations involving these short distance elements.

R.R. 107 A Research Methods Manual

The research activity of the Association has developed an effective and comprehensive set of methods for carrying on research in human motions. This report details the major techniques used. Adequate sources of motion data, film analysis, data recording, and statistical methods of analysis are among the topics discussed.

R.R. 108 A Study of Arm Movements Involving Weight

In this report, the results of a large investigation into the effect of weight on the performance times of arm movements are presented. While more effective means of determining correct time allowances for moving weights are given, the comprehensive discussion of the whole area of weight phenomena is probably of more fundamental importance. The effect of such conditions of performance as the use of one or two hands, sliding vs. spatial movements, and male and female performance are among the topics presented.

R.R. 109 A Study of Positioning Movements

I. The General Characteristics. II. Appendix.
This report, the first of two position reports, defines "positioning movements and the interrelation of component movements." The study is limited to the laboratory analysis, and contains an appendix dealing with several subjects outside the major objectives.

R.R. 110 A Study of Positioning Movements

III. Application to Industrial Work Measurement.
This report, the second on position, relates the results of the position research to the field of application. This study deals with actual industrial operators and work measurement tools, and the evolution of an improved and more efficient technique for controlling and improving manual activity through better understanding of positioning movements.